

APPENDIX 1

INFORMATION TECHNOLOGY INDUSTRIES–

OF GROWING IMPORTANCE TO THE ECONOMY AND JOBS

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INFORMATION TECHNOLOGY INDUSTRIES- OF GROWING IMPORTANCE TO THE ECONOMY AND JOBS

In the 1990s, information technology (IT) has altered the way businesses and consumers interact. Domestic and worldwide use of computer hardware and software products and communications equipment and services is converging into a single market. This market supports the global information infrastructure (GII), which is dominated by the Internet. Although IT is used by all industries to some degree, industries that support the GII are, for the purpose of this report, considered to be IT industries (Table 1). The criteria for the selection of IT industries and the methodology used to derive the charts below are described in the "Data and Methodology" section.

IT industries enable electronic commerce (e-commerce), thus their health and/or performance give some indication of the potential size and likely growth of e-commerce. This analysis presents an estimate of the size and growth of IT industries and their importance to overall U.S. economic and employment growth. Growth of IT industries provides us with some idea of the past and probable future success of e-commerce, but should not be interpreted as a direct measure of it.

IT Industries and Recent Economic Performance

The economy has been performing well lately, in terms of growth, employment, inflation, and productivity. Between 1996 and 1997, the economy grew 3.8 percent in inflation adjusted or real dollars, about 3 million new civilian employees were added, inflation remained low, 2.3 percent,¹ and business productivity increased by 1.9 percent. Some analysts believe that growth of the IT sector helps account for a large part of this good performance and the findings in this paper lend support to their assessments. In recent testimony to Congress, Federal Reserve Board Chairman, Alan Greenspan noted that

"... our nation has been experiencing a higher growth rate of productivity -- output per hour worked -- in recent years. The dramatic improvements in computing power and communication and information technology appear to have been a major force behind this beneficial trend."²

Other analysts believe, however, that other factors may account for recent good performance and that the data do not yet confirm whether the recent burst of activity in the IT sector has had large positive effects on the rest of the economy. Because of the lags between bursts of investment and their economic effects taking hold, we are not yet able to assess the full economic effects of the recent dramatic growth in IT investment.

One of the most notable developments in recent years has been the rapid increase in the IT sector's (computing and communications) share of investment activity and the overall economy. IT grew from 4.9 percent of the economy in 1985 to 6.1 percent in 1990. In 1990, the IT share of the economy was proportional to its contribution to overall economic growth. Beginning in 1994, however, the IT sectors contributed twice its share of the economy to overall nominal economic growth.

In 1996, IT industries accounted for an estimated 7.5 percent share of the economy³ and an estimated 15.8 percent of the rise in Gross Domestic Product (GDP), in current dollar terms as measured by its earned income. By 1997, IT industries accounted for an estimated 7.8 percent of GDP and 12.4 percent of its nominal growth, while in 1998, IT industries may account for as much as 8.2 percent of the economy and an estimated 14.7 percent of its nominal growth.

What makes this rise in IT's nominal share of the economy even more remarkable is the fact that IT prices, adjusted for quality improvements, have been falling while prices in the rest of the economy have been rising. In 1996 and 1997, declining prices in IT industries (as measured by their overall implicit deflator) lowered the annual change in prices in the overall economy by an estimated one full percentage point. Thus, the estimated real contribution of this sector to economic expansion was greater than what the nominal shares indicate. In recent years, an average of over one-quarter of total real economic growth can be attributed to IT industries.

In 1996, the IT workforce, as defined by employment in IT industries (Table 1) and employees with IT-related occupations (Table 2), across the economy, was 7.4 million workers (6.2 percent

Table 1. Information Technology Industries

SIC	Industry	SIC	Industry
Hardware		Software and Services	
3571,2,5,7	Computers and equipment	7371	Computer programming services
5045 pt.	Wholesale trade of computers and equipment	7372	Prepackaged software
5734 pt.	Retail trade of computers and equipment	5045 pt.	Wholesale trade of software
3578,9	Calculating and office machines, nec	5734 pt.	Retail trade of software
3695	Magnetic and optical recording media	7373	Computer integrated systems design
3671	Electron tubes	7374	Computer processing, data preparation
3672	Printed circuit boards	7375	Information retrieval services
3674	Semiconductors	7376	Computer services management
3675-9	Passive electronic components	7377	Computer rental and leasing
3823	Industrial instruments for measurement	7378	Computer maintenance and repair
3825	Instruments for measuring electricity	7379	Computer related services, nec
3826	Laboratory analytical instruments		
Communications Equipment		Communications Services	
3651	Household audio and video equipment	481, 22, 99	Telephone and telegraph Communications
3661	Telephone and telegraph equipment	4832	Radio broadcasting
3663	Radio and TV and communications equipment	4833	Television broadcasting
		4841	Cable and other pay TV services

of total employment) with an average annual wage of \$45,737,⁴ compared with a total employment of 119.6 million and an annual average wage of \$28,000 (for all private employees). The Bureau of Labor Statistics (BLS) projects that the demand for these workers will increase to 9.5 million by 2006.

The fastest growing segment of IT workers is in the software and services industries. Between 1985 and 1996, employment in these industries more than doubled from just over one-half million workers to 1.2 million with an average annual wage of about \$56,000. By 2006, BLS projects the demand for these workers to double again to 2.5 million.

The debate over the relation of IT industries to the health of the economy will continue for some time. Although the results of this paper suggest a healthy relationship, more data and analysis, especially in the area of IT-generated productivity improvements throughout the economy and the contribution to non-inflationary growth, are needed.

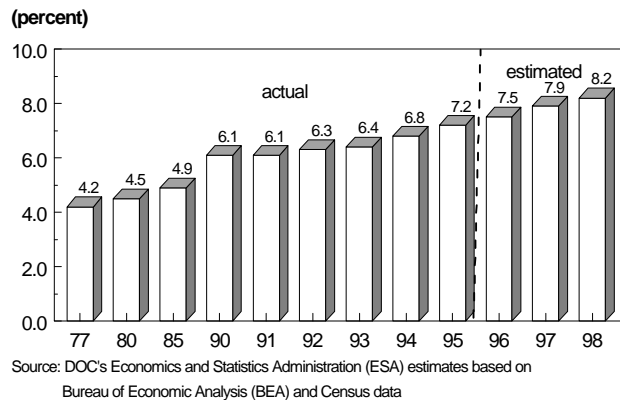
IMPACT ON ECONOMIC GROWTH, INFLATION, AND BUSINESS INVESTMENT

Share of the Economy and Contribution to Growth

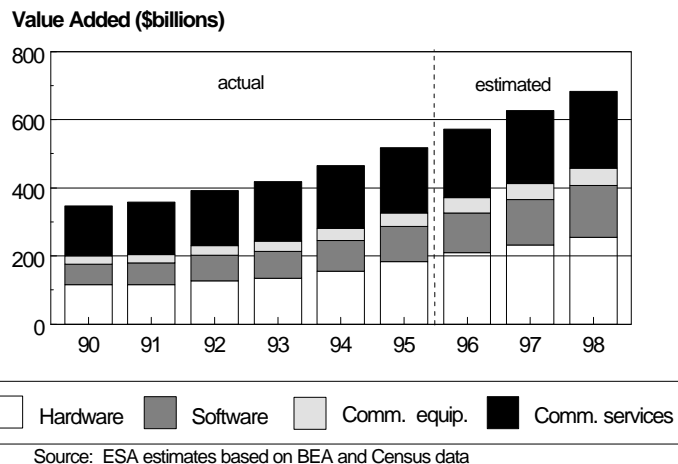
The IT share of the economy, in current dollars, hovered between 4- and 5-percent from the late 1970s through the mid-1980s (Figure 1). Then, as the personal computer became more common in business and in the home, the IT share of the economy jumped by 1.2 percentage points between 1985 and 1990 to reach 6.1 percent. With the commercialization of the Internet, it started its upward climb again, growing from 6.4 percent in 1993 to an expected 8.2 percent by 1998.

Between 1990 and 1998, value added of IT industries are expected to roughly double, growing from \$347 billion to \$680 billion (Figure 2). Hardware sales, comprised of computer hardware, electronic components, and some instruments, are expected to grow from \$116 billion in 1990 to \$254 billion by 1998—more than doubling over the period. Software sales are expected to increase by two and one-half times from \$60 billion to \$152 billion. Value added of the communications industries, by comparison, is expected to increase by about 60 percent, from \$171.2 billion in 1990 to \$276.5 billion in 1998.

**Figure 1. Information Technology Industries:
Share of the Economy Rises Slowly in the 1980s,
Accelerates in the 1990s**

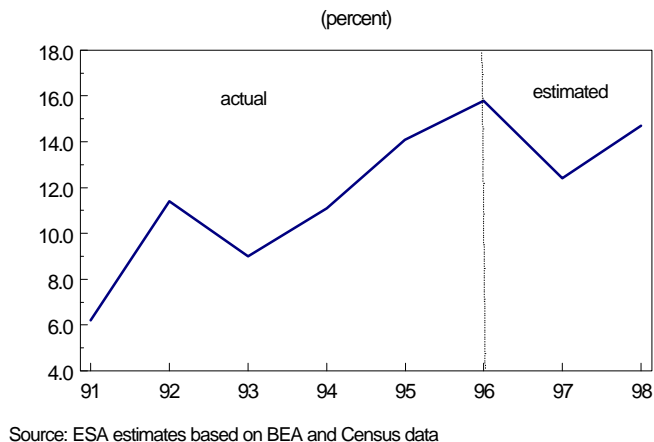


**Figure 2. While Communications Revenues Increase By Half
Computer Hardware and Software Sales More Than Double**



IT industries contributed a proportional share to the nominal growth of GDP in the early 1990s. For instance, in 1991, IT industries accounted for 6.1 percent of the economy and 6.2 percent of overall economic growth (Figure 3A). Since the commercialization of the Internet in the mid-1990s, IT's contribution to nominal GDP growth has expanded rapidly. Between 1994 and 1998, IT is responsible for 11-16 percent of overall economic growth, while its share of the economy ranges between 6.8-8.2 percent.

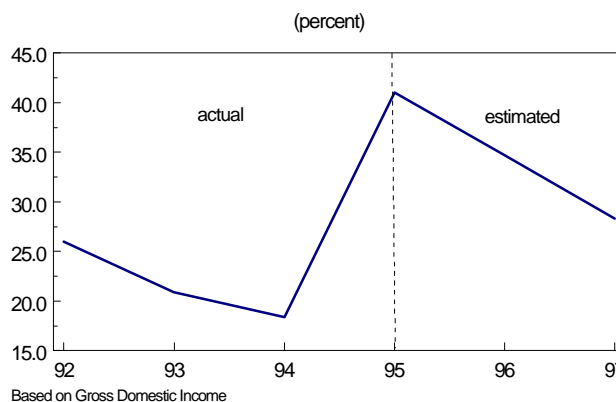
Figure 3A. IT Industries: Contribution to Economic Growth Rises from 6% in 1991 to Around 14% between 1995 and 1998



The contribution of IT industries to nominal growth in the economy understates its full impact. The difference between the nominal and real contributions to growth results from significant productivity growth in some of these industries. Large gains in the quality of IT products, particularly computers and semiconductors, have been achieved without comparable increases in costs.⁵

Between 1992 and 1997, IT industries contributed over one-quarter of the real growth in the economy.⁶ (Figure 3B) The IT contribution to real economic growth fluctuates considerably from year to year. From 1992 to 1994, IT growth was only slightly higher than overall economic growth.⁷ In 1995, a spurt of investment in IT products in combination with a rather lackluster economy resulted in a dramatic increase in the IT contribution to real economic growth. By 1997, the IT contribution to real economic growth dropped back down to just over one-quarter, primarily

Figure 3B. IT Industries Average Over One-Quarter of Total Real Economic Growth, 1992-1997



Source: ESA estimates based on BEA and Census data

because the rest of the economy was doing well.

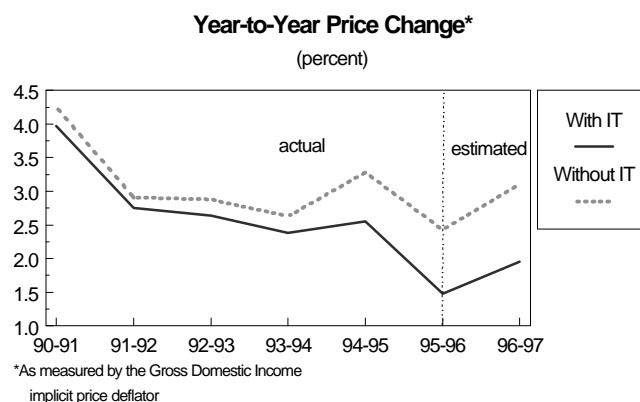
The inflation adjusted measure of the IT sector may overstate its practical contribution to overall economic growth, as businesses may not yet taking full advantage of the quality improvements in the IT products.

Inflation and IT Industries

Since 1996, the Bureau of Economic Analysis (BEA) has adopted quality-adjusted price indexes for computers and semiconductors for use in their real GDP calculations. The need to incorporate quality-adjusted deflators (sometimes called hedonic deflators) arose because of the increasing performance and declining prices of these products. Since the 1960s, the performance of microprocessors has followed Moore's Law--transistor (or microprocessor) density doubling about every 18 months. And during this time of phenomenal growth in performance, the average price of the transistor has fallen by an unprecedented six orders of magnitude. A doubling of microprocessor performance every 18 months is projected to continue for the next 20 years.⁸

With prices of computers and semiconductors falling, overall prices within IT industries have helped keep overall inflation down (Figure 4). Inflation in 1997, as measured by average prices in the overall economy,⁹ was 2.0 percent. Without IT industries keeping prices down, inflation would have been 3.1 percent. In 1996, overall price inflation would have been 0.9 percentage points higher without declining prices in IT industries.

Figure 4. IT Industries Helped to Keep Overall Inflation Down



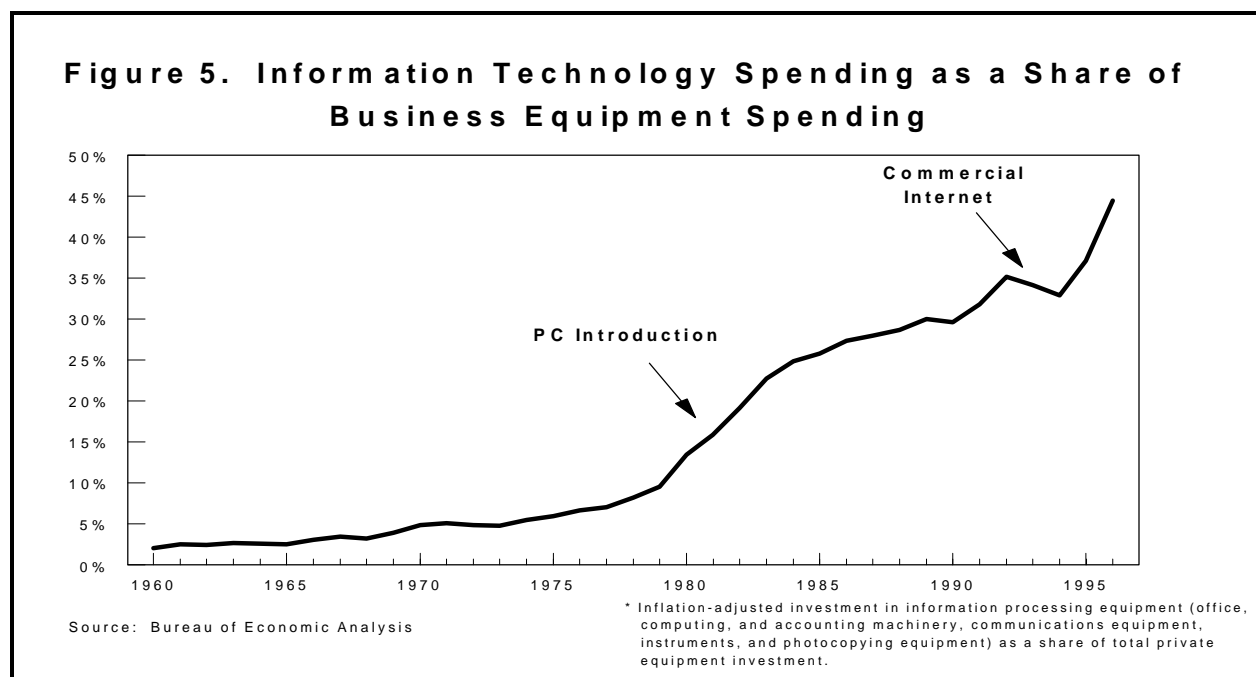
Source: ESA estimates based on BEA and Census data

Industry Use of IT Equipment

IT industries not only directly have more than proportional impact on the growth of the economy, but the use of IT products has been an important and growing part of capital investments across all industries. In 1994, of the 53 aggregate industry sectors (across the economy), 40 percent or more of the total capital stock of 15 industries was comprised of IT equipment, 13 between 25 and 39 percent, 20 between 10 to 24 percent, and only 5 had a less than 10 percent share. IT spending, in inflation adjusted dollars,¹⁰ as a share of total business equipment spending, grew

from negligible to 45 percent in a little over 30 years (Figure 5). In 1965, business spending for IT equipment was less than 5 percent of total business spending. By the early 1980s, IT spending jumped to about 15 percent. In the early 1990s, IT spending represented about one-third of all business equipment spending, and by 1996, almost half. The slope of the curve suggests that by 2000, business spending for IT equipment should exceed half of all spending on capital equipment.

A parallel can be drawn between the proliferation of computers (and other IT equipment) in the last three decades and the spread of electricity in the mid 1800s and early 1900s.¹¹ First harnessed



in 1831, electricity's potential had to wait 50 years until the first power station was built in 1882.¹² Industry then began a 50-year transition from using mechanical power to using power generated by electricity. In 1899, less than 5 percent of the power used by industry was from electric power generation. Fifty years later, electricity powered 80 percent of factories and households across the country.

The increase in the share of IT-related capital by industries corresponds to a decline in the share of the other categories of business equipment and can be viewed as evidence of basic structural change among and within industries. Between 1977 and 1996, the share of business spending for the major categories of capital equipment (with the exception of IT) declined—the share of business spending for industrial equipment such as engines and machinery dropped by 5 percentage points over this period (year-end estimates); transportation equipment, such as trucks and autos, dropped by 2 percentage points; and other capital equipment, such as office furniture,

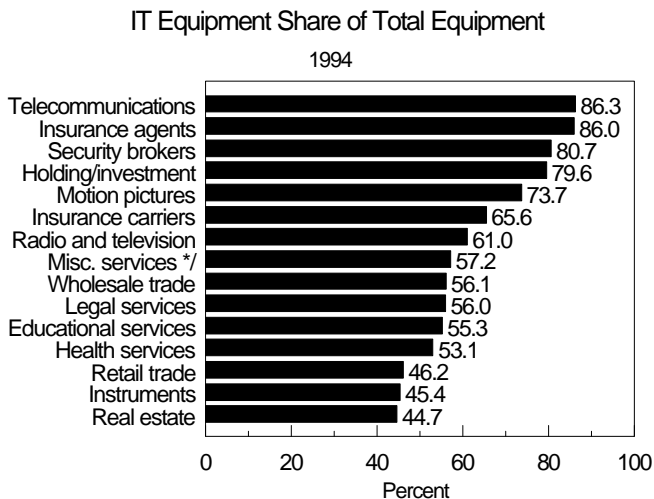
dropped 3 percentage points. At the same time, the share of business spending for IT-related equipment increased by 10 percentage points.

In some industries such as telecommunications, insurance, and securities brokerages, IT equipment constitutes over eighty percent of all the equipment used (Figure 6).

IT equipment used per employee is another measure of IT intensity (Figure 7). The top 15 industries, ranked by this criterion, include telecommunications, real estate, radio and television, nonbank financial companies and utilities. They spend over \$10,000 (1987 dollars) per employee compared with an economy-wide average of \$2,500. By this measure, while telecommunications remains at the top, other industries such as banks, petroleum, chemicals, and railroad transportation make it to the top tiers as major users of IT equipment.

Industries that are major users of IT equipment, as shown in Figures 6 and 7, constitute about half of the economy and employ about half the workforce.

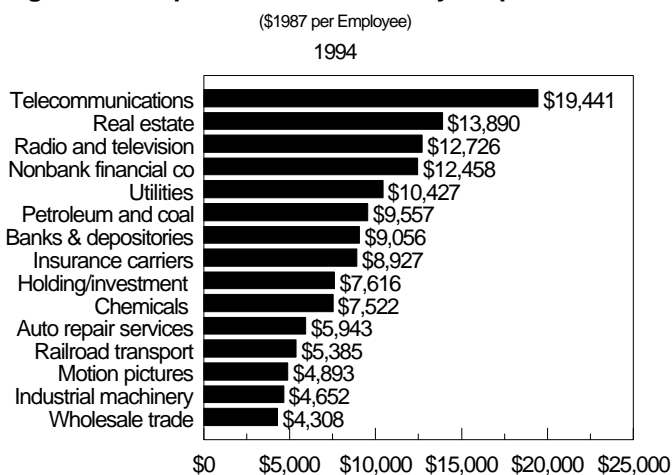
Figure 6. IT Net Capital Stock - Top 15 Industries



Source: Bureau of Economic Analysis

*/ Includes social, management, engineering, and services n.e.c.

Figure 7. IT Capital Investment Intensity - Top 15 Industries



Source: Bureau of Economic Analysis

THE IT WORKFORCE

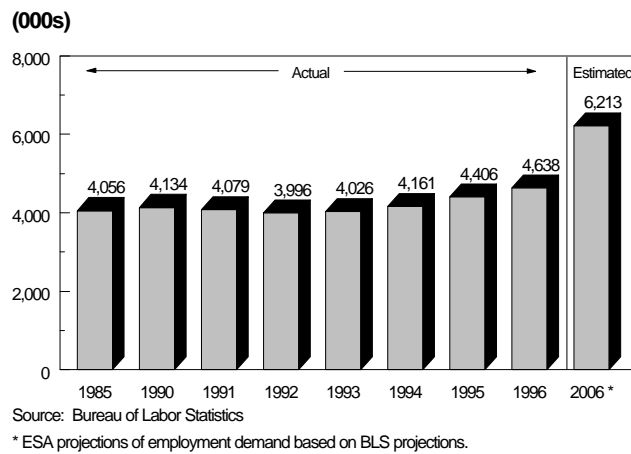
Total employment in IT-related jobs is defined as all employees in IT industries and all employees in IT-related occupations in non-IT industries.¹³ In 1996, 7.4 million people worked in the IT workforce. Approximately two-thirds of these jobs were in IT industries, the other one-third were spread across the rest of the economy. The sections that follow include a separate analysis of employment in IT industries followed by a discussion of employment in IT-related occupations. Note that workers in IT industries and workers with IT-related occupations are not additive since approximately one-third of the workers with IT-related occupations are in IT industries.

Employment in IT Industries

Employment in IT industries has remained relatively stable even as its share of the economy has grown (Figure 8). From 1985 to 1990, employment in IT industries grew at only 0.4 percent annually, much slower than the 2.4 percent annual rate of growth for all private industries.

IT industries have made a small but positive contribution to overall private employment growth, especially since 1993. IT industries contributed very little to the decline in employment from 1990 to 1991, with a loss of only 56,000 of the 1.2 million jobs lost. They supplied over 230,000 of the 2.2 million increase in jobs from 1995 to 1996, or 10.5 percent (Figure 9).

Figure 8. Information Technology Industries: Employment Accelerates after Remaining Flat for Several Years



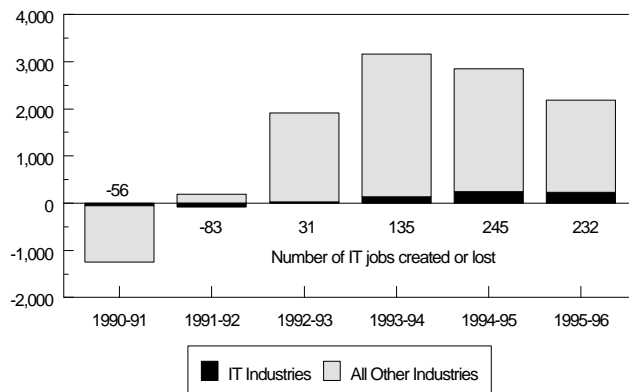
Employment in IT industries is projected to increase 3.0 percent annually from 1996 to 2006, more than twice as fast as the U.S. average of 1.4 percent.

Although historical employment data suggest little change in aggregate IT employment, there has been a fundamental shift in employment among industries. IT industries that produce computer

hardware and communications equipment have lost jobs as technological changes have made some processes routine, thus eliminating jobs or reducing the need for in-house staff to perform some jobs.¹⁴ Increased outsourcing is reflected in increased employment in IT industries that provide maintenance and other support services. Also, more computer assembly is being done at the wholesale level.

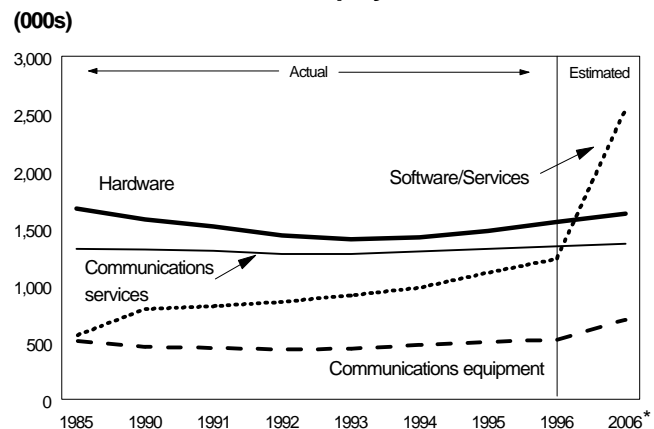
Among the four IT industry groups, providers of software and services have experienced the most rapid employment growth. From 1985 to 1996, employment in these industries more than doubled from 557,000 to 1.2 million workers, with the fastest growth occurring in the computer programming and prepackaged software industries (Figure 10). By 2006, software and services employment will more than double again to 2.5 million workers, still driven by computer programming and prepackaged software industries. Communications equipment and communications services have seen slow employment growth, despite above average growth in sub-industries such as household audio and video equipment retail stores and cable television. In 1996 there were 116,000 fewer workers in industries that produce computer and related hardware than in 1985. However, employment in several sub-industries such as computer retail sellers and manufacturers of laboratory analytical instruments has grown faster than average.

Figure 9. Information Technology Industries: Contribution to Private Employment Growth is Small but Growing (000s)



Source: ESA estimates based on Bureau of Labor Statistics data.

Figure 10. Software/Services Industries Lead IT Industries in Employment Growth

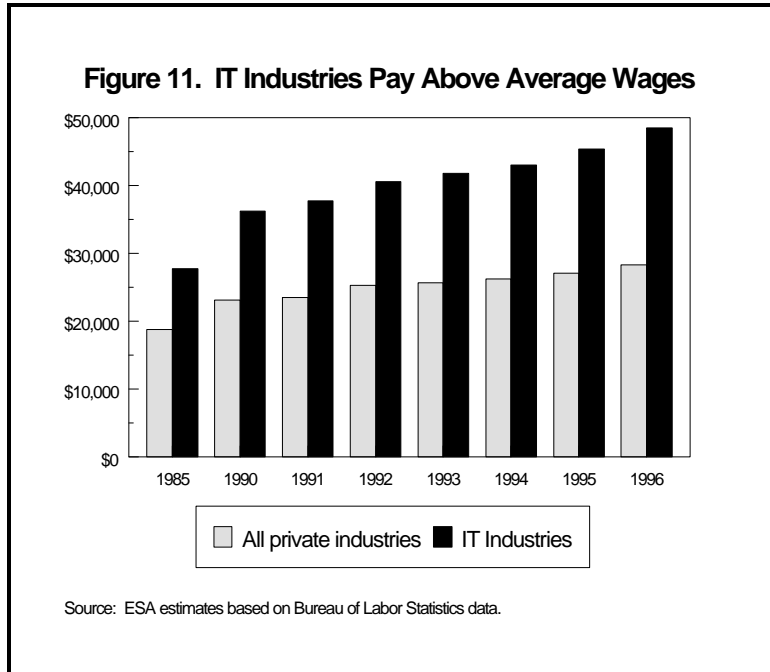


Source: Bureau of Labor Statistics

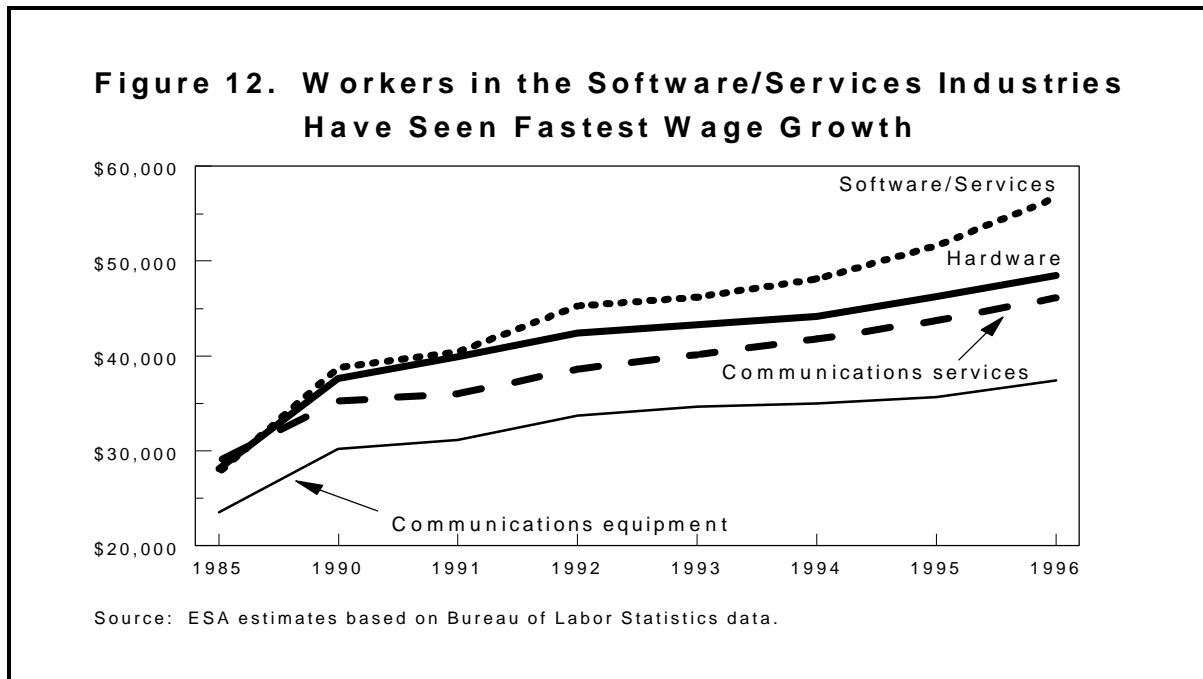
* ESA projections of employment demand based on BLS projections.

Earnings of Workers in IT Industries

IT industries represent a small, but growing share of the total annual wage bill, accounting for 7.9 percent of all wages paid in 1996 compared with 7.4 percent in 1985. Strong growth in value added of the IT industries in the 1990s and rapid growth in productivity (as measured by value added per employee) resulted in a corresponding increase in wages (Figure 11). Wages of IT workers have been growing at 5.2 percent annually since 1985 compared with 3.8 percent for all private workers. In 1996, the average annual wages paid to workers in IT industries was almost \$48,000 compared with \$28,000 for all private employees.



Among the IT industries, workers in the software and services industries earned the highest annual wages, almost \$56,000 in 1996 (Figure 12). This group also had the fastest increase in annual wages) growing at 6.6 percent annually since 1985. Average earnings of workers in the



hardware-related and communications services industries were similar at around \$46,000 to \$48,000 per year. Communications equipment workers earned about \$37,000 annually.

Employment in IT Occupations

In addition to the IT industries themselves, IT workers are needed across the economy to install, operate, program, repair, maintain, design and develop IT equipment and services (Table 2).

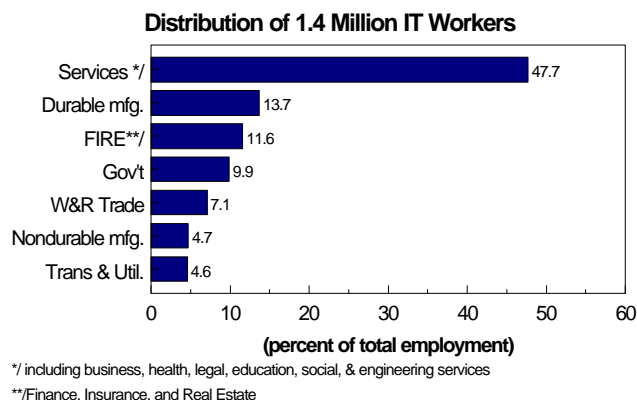
Table 2. IT-Related Occupations

Engineering, science, and computer systems managers	Computer engineers, scientists, and systems analysts
Electrical and electronic engineers	Computer programmers
Electrical technicians	Computer and peripheral equipment operators
Electrical power line installers and repairers	Data entry keyers
Electronics repairers	Electronic equipment assemblers
Communications equipment operators	Data processing equipment repairers
Central office and PBX installers and repairers	Broadcast technicians
Calculating machine operators	Duplicating machine operators
Electronic semiconductor assemblers	Electromechanical equipment assemblers
Telephone and Cable TV installers and repairers	Electrical and electronic assemblers

In 1996, 4.2 million people worked in IT-related occupations. About one-third of these workers (1.4 million) were employed by IT industries and 2.8 million worked in non-IT industries. As an example, in 1996 there were 1.4 million computer scientists, systems analysts, computer engineers, and computer programmers. The services sector employed 47.7 percent of these workers—primarily in business services, health services, education, and engineering services. Durable goods manufacturing industries, financial services, and government were other large employers (Figure 13).

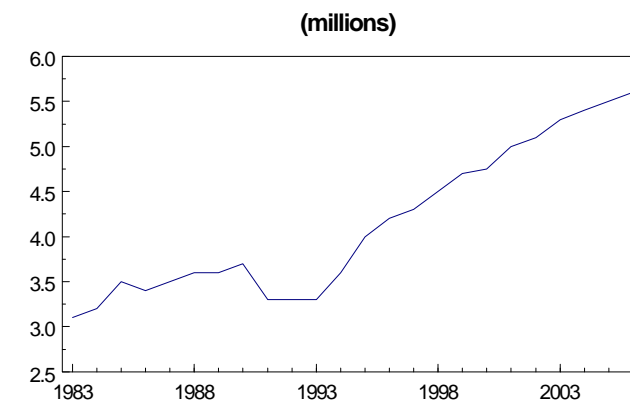
The number of IT workers increased from 3.1 million in 1983 to 3.7 million in 1990 (Figure 14). After the slight decline in the early 1990s, IT jobs grew to 4.2 million by 1996. (Table 3 briefly describes some of these occupations.¹⁵)

Figure 13. Employment of Computer Engineers, Scientists, Systems Analysts, and Computer Programmers, 1996



Source: ESA estimates based on BLS data

Figure 14. Employment in IT Occupations Across All Industries, 1983-2006



Source: ESA estimates based on BLS data

Table 3. Some IT-Related Occupations

Engineering, Science, and Computer Systems Managers plan, coordinate, and direct research, development, design, production, and computer-related activities. Many have a bachelor's or master's degree in computer or information science. In 1996, the mean annual wage of these managers was almost \$66,000.

Computer engineers, scientists, and systems analysts--Computer engineers work with the hardware and software aspects of systems design and development. Computer scientists generally design computers and the software that runs them, and conduct research. Systems analysts use their skill in computers to develop business specific applications. Ph.D.'s or, at least master's degrees, are preferable for scientists and engineers in research labs or academic institutions. In 1996, the mean annual wage of computer engineers was almost \$55,000. The mean annual wage of systems analysts and computer programmers, combined, was \$48,000.

Electrical and Electronics Engineers design, develop, test, and supervise the manufacture of electrical and electronic equipment, including computer hardware, and communications and video equipment. A bachelor's degree is required for beginning engineers. In 1996, their mean annual wage was about \$53,000.

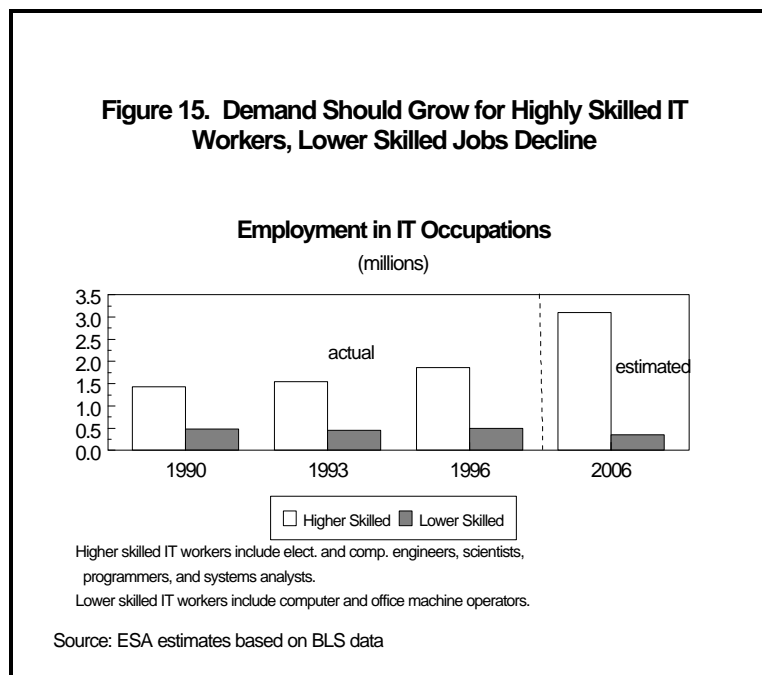
Computer programmers write and maintain the detailed instructions that computers must execute to perform their functions. There are no universal training requirements for programmers, although the majority hold a four-year degree. In 1996, the mean annual wage of these workers (combined with systems analysts) was \$48,000.

Communications Equipment Mechanics install, repair, and maintain complex and sophisticated communications equipment. Most employers prefer one to two years of training in electronics. In 1996, the mean annual wage for central office and PBX installers and repairers was about \$40,000.

Broadcast Technicians install, test, repair, set up, and operate electronic equipment used to record and transmit radio and television programs. Employers prefer workers with training in broadcast technology or in engineering or electronics. A four-year college degree is not a prerequisite. In 1996, their mean annual wage was about \$31,000.

Computer and Office Machine Repairers install, maintain, and repair computer and office equipment. Most employers prefer applicants with formal one- to two-year training in electronics specializing in computers. In 1996, their mean annual wage was \$29,000.

BLS projects that 5.6 million workers will be needed to fill IT-related jobs by 2006. The demand for higher skilled IT jobs is expected to grow dramatically while the demand for lesser-skilled IT jobs is expected to decline (Figure 15). For instance, jobs for computer engineers, scientists, and systems analysts which typically require at least a four-year college degree, grew from 474,000 in 1990 to 874,000 in 1996. By 2006, BLS projects that 1.8 million people will be needed to fill these jobs. The demand for computer programmers, jobs requiring two to four years of college or advanced training, is expected to increase, rising from 548,000 in 1996 to 665,000 in 2006. On the other hand, lesser-skilled jobs like computer operators and duplicating machine operators, which only require a high school diploma, are expected to decline from 481,000 in 1996 to 342,000 in 2006.



The Internet is also driving demand for workers with IT skills. Workers are needed to design Web pages, create graphics, code documents in Hypertext Markup Language (HTML) and program in Internet languages such as Java and C++. Webmasters responsible for the design, development, operation, and maintenance of Web sites earn starting salaries between \$35,000 and \$50,000; highly experienced webmasters earn \$100,000 or more. Web developers, responsible for the actual creation of the Web site, are reported to earn a median salary of \$55,000. On the lower end of the skill level in Internet jobs, customer service representatives that work for Internet Service Providers earn from \$14,000 to \$17,000 per year and up to \$35,000 depending on experience.¹⁶

The demand for computer engineers, scientists, systems analysts, and computer programmers is expected to continue to increase through 2006. Despite this growth and anticipated demand, the number of U.S. graduates with a bachelor's degree in computer science declined by 40 percent

between 1986 and 1994. However, a bachelor's degree in computer science is not the only path of entry into an IT occupation. Other related academic fields, such as computer engineering and business information systems, can supply workers in these categories and even graduates in many non-science and engineering fields are employed in IT-related occupations.

At the same time demand for workers to fill IT-specific jobs is increasing, workers in a variety of non-IT occupations find themselves using computers and computerized devices—PCs, CAD, and CAM machines, computerized measuring and analytical instruments, testing and diagnostic equipment—to perform their jobs. Somewhat dated statistics (1993) show that nearly half of all workers regularly use a computer in their jobs, with even higher usage among more highly-skilled and educated workers.¹⁷ Preparing students and workers to meet current and future labor market demand will require a new and determined commitment to education and training in mathematics and science.

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DEFINING INFORMATION TECHNOLOGY INDUSTRIES

The first task in analyzing the IT sector was to choose a set of industries upon which to base the analysis. In this definition, IT industries produce, process, or transmit information goods and services as either intermediate demand (inputs to production to other industries) or as final products to consumption, investment, government purchases, or exports.¹⁸ Other industries were considered to be IT industries since they provide the necessary infrastructure (communications) for the Internet to operate (Table 4).

IT industries are classified (and defined) according to the 1987 SIC manual, published by the Office of Management and Budget. IT industries are further separated into categories of Hardware, Software and Services, and Communications.

Hardware industries include computers and equipment, including their wholesale and retail sales, office machines, semiconductors, some other electronic component industries, and industries that produce measurement and laboratory analytical instruments. Wholesale sales of computers and equipment was included to capture the sales by manufacturers through their branch offices, accounted for by the Census as a wholesale sale. These sales were considered to be closely aligned with a manufacturer's sale; excluding their sale would result in a serious undercount. Retail sales were included in order to capture all other sales of computers.

Software and services industries include those that provide prepackaged software and services associated with computers. There is some concern that direct sales of software are underestimated because government data only detail the sales of prepackaged software for microcomputers. The cost of software loaded onto a mainframe computer for business or government use, therefore, may not be captured. A much greater problem exists with respect to international trade of software. In this case, the software cost reported to the Customs Bureau as an import might include only the cost of the cassette or CD-ROM. Once in the U.S., the software could be copied and resold any number of times. The same might be true for a U.S. manufacturer with foreign affiliates. In this case, the software could be developed in the U.S. and a single copy sent to their foreign affiliate and copied overseas to be used in their computer production. Accounting for these transactions is difficult to do, if not impossible.

Communications equipment and services industries were selected as IT industries since they provide the "infrastructure" that allows the connections between computers and servers that enable electronic commerce and provide the highways for access and movement.

Despite the attempt to cleanly designate the IT sector, there will always be some subjectivity with the data that are used to measure it. As IT goods and services are increasingly incorporated into non-IT goods and services, it is difficult to draw hard-and-fast boundaries. For instance, semiconductors are used in computers, but they are also used in automobiles, home appliances, and a variety of other goods. Because they provide computing power and intelligence to all of these products, we have included the entire semiconductor industry as IT. Similarly, the majority

of revenue by the telecommunications industry is still generated by traditional telephone service. Over time, however, virtually all IT investment will be part of interlinked communication systems.

Table 4. Information Technology Industries

Hardware Industries	SIC	NAICS
Computers and equipment	3571, 2, 5, 7	334111, 2, 3, 9
Wholesale trade of computers and equipment	5045 pt.	42143 pt.
Retail trade of computers and equipment 5734 pt.	44312 pt.	
Calculating and office machines, nec	3578, 9	334119, 333313, 339942, 334518
Magnetic and optical recording media	3695	334613
Electron tubes	3671	334411
Printed circuit boards	3672	334412
Semiconductors	3674	334413
Passive electronic components	3675-9	334414, 334415, 334416, 334417, 334418, 336322, 334419
Industrial instruments for measurement	3823	334513
Instruments for measuring electricity	3825	334416, 334515
Laboratory analytical instruments	3826	334516
Software/Services Industries		
Computer Programming Services	7371	541513
Prepackaged software	7372	51121, 334611
Wholesale trade of software	5045 pt.	42143 pt.
Retail trade of software	5734 pt.	44312 pt.
Computer integrated systems design	7373	541512
Computer processing, data preparation	7374	51421
Information retrieval services	7375	514191
Computer services management	7376	541513
Computer rental and leasing	7377	53242
Computer maintenance and repair	7378	44312, 811212
Computer related services, nec.	7379	541512, 541519
Communications Equipment Industries		
Household audio and video equipment	3651	33431
Telephone and telegraph equipment	3661	33421, 334416, 334418
Radio and TV and communications equipment	3663	33422
Communications Services Industries		
Telephone and telegraph communications	481, 22, 99	513321, 513322, 51333, 51331, 513322, 51334, 51339
Radio broadcasting	4832	513111, 513112
Television broadcasting	4833	51312
Cable and other pay TV services	4841	51321, 51322

Note: Since the government is in the process of converting data collected under the SIC code to data collected under the NAICS code, both are provided here.

Due to the difficulty in isolating IT, no standard definition exists. Different governmental and private sector bodies propose their own definitions, sometimes breaking out IT as a separate sector, sometimes including it as part of a set of industries that they consider to be high-tech.

For example, BEA assesses high-technology industries. In addition to computer equipment and communications industries, their high-tech list includes those that produce an array of hardware for the national defense (military aircraft, aircraft engines, and electronics). The Bureau of the Census has just launched the use of the new industry classification system, called the North American Industry Classification (NAICS)—replacing the current SIC system—in their 1997 Economic Census. The NAICS provides for a new Information Sector, but its focus is primarily on industries that produce information and not hardware items such as computers or communications equipment.

The Organization for Economic Co-operation and Development (OECD) Statistical Panel of the Committee on Information, Computers, and Communications Policy, in August 1997, proposed a draft definition of the Information and Communications Technologies (ICT) sector.¹⁹

Industry associations have also produced varying definitions of IT and high-tech industries, but their selection was in part driven by their membership. For example, the American Electronics Association (AEA) provides an extensive list of industries that they consider as High Technology, inclusive of industries considered to be IT.²⁰ The Information Technology Institute's (ITI) list of IT industries includes a number of those that are also considered IT by the AEA, except for electronic component industries. Many of the industries included in these various definitions of IT are common. A number are not (Table 5).

Table 5. Comparison of Industries Selected as IT (or High Tech) by Different Organizations

SIC	Industry		This Study	ITI	AEA	NAICS
3571	Electronic computers		yes	yes	yes	no
3572	Computer storage devices		yes	yes	yes	no
3575	Computer terminals		yes	yes	yes	no
3577	Computer peripheral equipment		yes	yes	yes	no
5045 pt.	Wholesale trade of computers and equipment	yes	no	no	no	
5734 pt.	Retail trade of computers and equipment		yes	no	no	no
3578	Calculating and accounting machines		yes	yes	yes	no
3579	Office machines, nec		yes	yes	yes	no
3671	Electron tubes		yes	no	yes	no
3672	Printed circuit boards		yes	no	yes	no
3674	Semiconductors		yes	no	yes	no
3675	Electronic capacitors		yes	no	yes	no
3676	Electronic resistors		yes	no	yes	no
3677	Electronic coils		yes	no	yes	no
3679	Electronic components, nec		yes	no	yes	no
3695	Magnetic and optical recording media		yes	no	no	no
3823	Industrial instruments for measurement		yes	no	yes	no
3825	Instruments for measuring electricity		yes	no	yes	no
3826	Laboratory analytical instruments	yes	no	yes	no	
3651	Household audio and video equipment		yes	no	yes	no
3661	Telephone and telegraph equipment		yes	yes	yes	no
3663	Radio and TV communications equipment		yes	no	yes	no
4812	Radiotelephone communications	yes	no	yes	yes	
4813	Telephone communications		yes	yes	yes	yes
4822	Telegraph and other message communications		yes	no	yes	yes
4832	Radio broadcasting		yes	no	no	yes
4833	Television broadcasting		yes	no	no	yes
4841	Cable and other pay TV services	yes	no	yes	yes	
4899	Communications services, nec		yes	no	no	yes
7371	Computer programming services	yes	yes	yes	yes	
7372	Prepackaged software	yes	yes	yes	yes	
5045 pt.	Wholesale trade of software		yes	no	no	no
5734 pt.	Retail trade of software		yes	no	no	no
7373	Computer integrated systems design		yes	yes	yes	no
7374	Computer processing and data preparation		yes	yes	yes	yes
7375	Information retrieval services		yes	yes	yes	yes
7377	Computer services management		yes	yes	yes	no
7378	Computer rental and leasing		yes	yes	yes	no
7379	Computer related services, nec		yes	yes	yes	no
Other Industries						
2711	Newspaper publishing	no	no	no	yes	
2721	Periodical publishing		no	no	no	yes
2731	Book publishing		no	no	no	yes
2741	Misc. Publishing, including databases		no	no	no	yes
2761	Manifold business forms		no	yes	no	no
2771	Greeting card publishing		no	no	no	yes
3652	Phonographic records	no	no	yes	no	
3669	Other communications equipment	no	no	yes	no	
3812	Search and navigation equipment	no	no	yes	no	
3822	Environmental controls		no	no	yes	no
3824	Fluid meters and counting devices	no	no	yes	no	
3827	Optical instruments		no	no	yes	no
3829	Other measuring and controlling devices		no	no	yes	no
3844	X-ray apparatus		no	no	yes	no
3845	Electromedical apparatus		no	no	yes	no
3861	Photographic equipment and supplies		no	yes	yes	no
7383, 89	News syndicates, business services, nec		no	no	no	yes
78	Motion pictures		no	no	no	yes

APPROACH USED TO MEASURE IT INDUSTRIES

This paper measures the contribution of IT industries to economic output and growth, inflation, business investment, and employment. Output of IT industries is measured in terms of value added. Value added is equal to total receipts (also known as sales or revenues) and other operating income less purchases of intermediate goods and services from other industries (adjusted for salable inventories) and imports minus purchased operating expenses. Value added can be thought of more directly; i.e., value added is the sum of all earned income of an industry including its salaries and wages, benefits, business taxes, and profits.

Value added can be added across industries to produce an aggregate measurement of the IT sector. The value added of all industries is equal to the Gross Domestic Income (GDI). This method of estimating these industries' share of the economy is commonly called an "income" side approach.

A "product" side approach could be used as an alternative. The product side approach adds final expenditures (final demand) on commodities produced by industries by major segments of the economy—consumption, investment, net exports, and government. Final demand across all industries is equal to Gross Domestic Product (GDP). Theoretically, the estimates from the income and the product sides should be the same. In practice, they are not and the difference between GDI and GDP is officially known as the "statistical discrepancy."²¹

The income, rather than the product, side approach was used in this analysis since the industry detail (shown in Table 4) available using government value added data exceeds the detail of the available data on commodities. Also, the commodity data are not consistently reported across all components of GDP. The income side approach based on industry data, therefore, allows for more precision in measuring industries. On the other hand, the income side approach forces the analyst to make a number of assumptions about the data, detailed in the next section on value added.

The IT workforce is defined as all employees in IT industries and all workers in IT-related occupations, across all industries and government. Care was taken to not double count workers with IT-related occupations working in IT industries. IT employment is presented in two parts-- (1) total employment across IT industries and (2) total employment in occupations that are considered to be IT-related. Data are based on historical reporting and projections made by the BLS. The occupations chosen as IT-related were selected in consultation with BLS and other agencies (Table 6).

**Table 6. IT-Related Occupations,
By BLS Occupation Classification**

<u>Occupation</u>	<u>BLS Code*</u>
Engineering, science, and computer systems managers	130170008
Electrical and electronics engineers	221260054
Computer systems analysts, engineers, and scientists	251970087
Electrical and electronic technicians and technologists	225250250
Broadcast technicians	340280274
Computer programmers	251060275
Communications equipment operators	571000332
Computer operators	561000340
Data entry keyers, except composing	560170405
Duplicating, mail, and other office machine operators	562000407
Central office and PBX installers and repairers	855020643
Data processing equipment repairers	857050651
Electrical power line installers and repairers	857230652
Electronics repairers, commercial and industrial equipment	857170654
Telephone and cable TV line installers and repairers	857020656
Electrical and electronic equipment assemblers, precision	931140716
Electromechanical equipment assemblers, precision	931110707
Electronic semiconductor processors	929020927

*Codes used in industry-occupation matrices for 1996-2006

VALUE ADDED OF IT INDUSTRIES, 1990-95

Sources used to provide value added are from published U.S. government documents. The specific sources of data that follow are from the Department of Commerce's Bureau of the Census or BEA.²² The following is a description of the data and estimates made to derive value added for the (1) manufacturing IT industries, (2) the software and services IT industries, (3) the communications services IT industries, (4) the wholesale trade of computer equipment and software, and (5) the retail trade of computer equipment and software (Table 7).

Value added for IT manufacturing industries, including the hardware and communications equipment IT industries were taken directly from the *Annual Survey of Manufacturers* (ASM) and the *1992 Census of Manufacturers* (COM) published by the Bureau of the Census. The latest published ASM is for 1995. The 1996 ASM will be available in 1998. The next COM will be for 1997 and will include industries classified according to the NAICS definitions. Value added of the hardware IT sector increased from \$116.1 billion in 1990 to \$183.6 billion in 1995. The IT communications equipment sector increased from \$24.5 billion in 1990 to \$39.9 billion in 1995.

Value added for the software and services IT industries was derived using the Census series

**Table 7. Information Technology Industries:
Share of the Economy and Contribution to Economic Growth, 1990 -1998**

Industry	SIC	1990	1991	1992	1993	1994	1995	1996	1997	1998
		(Value Added: \$millions, except as noted)						estimate	estimate	estimate
Total Gross Domestic Product (GDP)*		5,726,400.0	5,906,600.0	6,199,700.0	6,505,500.0	6,932,400.0	7,293,600.0	7,636,600.0	8,081,000.0	8,461,644.0
Year-to-Year GDP Change (%)			3.15%	4.96%	4.93%	6.56%	5.21%	4.70%	5.82%	4.71%
Hardware										
Computers and equipment	3571,2,5,7	28,676.8	25,091.1	26,630.8	26,941.6	31,351.6	32,931.2	37,153.6	41,273.2	45,081.8
Computers and equipment wholesale sales	5045 pt	33,599.0	35,747.0	39,465.0	42,275.0	43,249.0	50,756.0	61,129.0	67,907.0	74,173.3
Computers and equipment retail sales	5734 pt	1,857.2	1,888.5	1,915.3	1,994.9	2,505.2	2,513.8	2,836.1	3,150.6	3,441.3
Calculating and office machines, nec	3578,9	2,606.6	2,327.4	2,613.3	2,742.2	2,811.1	3,036.2	3,172.8	3,322.0	3,478.1
Electron Tubes	3671	1,317.8	1,131.0	1,280.4	1,135.8	1,357.3	1,472.9	1,542.7	1,622.9	1,716.8
Printed circuit boards	3672	4,997.2	3,443.9	4,348.3	4,160.0	5,041.7	5,718.5	6,518.6	7,104.9	7,602.8
Semiconductors	3674	17,855.0	20,151.9	22,299.7	26,465.2	36,266.3	51,272.0	57,932.8	64,305.4	70,092.2
Passive electronic components	3675-9	13,099.4	13,923.4	16,485.0	16,071.8	18,435.2	19,097.6	22,110.7	25,515.5	29,801.9
Industrial instruments for measurement	3823	3,764.7	3,765.7	4,182.9	4,238.0	4,585.6	4,998.5	5,139.7	5,345.2	5,546.9
Instruments for measuring electricity	3825	5,352.4	5,455.6	5,721.1	5,594.2	6,678.0	7,512.3	7,766.0	8,030.0	8,399.0
Laboratory analytical instruments	3826	3,018.7	3,134.0	3,004.8	3,356.8	3,635.3	4,270.6	4,278.9	4,553.1	4,780.9
Total Hardware		116,144.8	116,059.5	127,946.6	134,975.5	155,916.3	183,579.6	209,580.9	232,129.7	254,115.0
Software/Services										
Computer programming services	7371	14,902.9	16,341.6	18,137.5	19,548.9	22,673.8	26,178.3	n.a.	n.a.	n.a.
Prepackaged software	7372	10,615.1	11,760.6	14,174.0	15,835.0	17,729.6	19,971.7	n.a.	n.a.	n.a.
Prepackaged software wholesale sales	5045 pt	1,697.0	1,806.0	1,994.0	2,136.0	2,185.0	2,564.0	n.a.	n.a.	n.a.
Prepackaged software retail sales	5734 pt	93.8	94.7	96.1	100.0	125.6	126.1	n.a.	n.a.	n.a.
Computer integrated systems design	7373	9,424.2	10,033.5	11,505.0	12,465.5	13,829.2	15,025.1	n.a.	n.a.	n.a.
Computer processing and data preparation	7374	10,256.1	10,833.9	12,226.0	13,009.4	15,332.9	17,924.5	n.a.	n.a.	n.a.
Information retrieval services	7375	2,435.2	2,534.1	2,803.9	1,963.2	3,188.4	3,768.5	n.a.	n.a.	n.a.
Computer services management	7376	1,369.0	1,514.6	1,860.2	1,811.2	1,932.0	2,135.2	n.a.	n.a.	n.a.
Computer rental and leasing	7377	1,587.9	1,438.9	1,488.1	1,352.5	1,324.2	1,329.0	n.a.	n.a.	n.a.
Computer maintenance and repair	7378	4,273.9	4,244.5	4,859.0	4,615.2	4,740.4	5,023.7	n.a.	n.a.	n.a.
Computer related services, nec	7379	3,006.0	3,424.6	4,291.2	5,147.5	6,685.9	8,549.1	n.a.	n.a.	n.a.
Total software and services	7371-9	59,661.1	64,027.0	73,435.0	77,984.4	89,747.0	102,595.2	116,958.5	133,332.7	151,999.3
Communications										
Household audio and video equipment	3651	1,892.0	2,122.4	2,280.1	2,567.4	2,650.2	2,343.0	2,913.7	2,830.4	2,767.6
Telephone and telegraph equipment	3661	9,619.4	9,502.5	12,463.1	13,589.9	14,235.6	14,925.2	15,613.8	16,463.5	17,373.7
Radio and TV and communications equipment	3663	11,278.0	10,339.3	12,246.9	11,929.8	16,825.3	19,862.0	23,019.9	25,445.1	27,854.3
Magnetic and optical recording media	3695	1,675.6	1,959.9	2,091.5	2,388.0	2,629.4	2,787.8	3,446.9	3,367.8	3,293.0
Total Communications Hardware		24,465.0	23,924.1	29,081.6	30,475.1	36,340.5	39,918.0	44,994.3	48,106.8	51,288.6
Telephone and telegraph communications	481,22, 99	119,100.0	123,700.0	129,700.0	134,600.0	142,100.0	144,100.0	149,600.0	157,379.2	163,674.4
Radio broadcasting	4832	3,742.5	4,039.9	3,980.3	5,218.6	5,573.5	6,149.6	7,291.5	8,014.2	8,695.8
Television broadcasting	4833	11,757.1	11,828.7	11,944.9	14,694.0	15,606.5	17,102.7	18,372.8	19,354.0	20,975.6
Cable and other pay TV services	4841	12,100.4	14,631.4	15,574.8	21,087.4	21,320.0	24,247.7	24,935.7	28,427.0	31,838.3
Total Communications Services		146,700.0	154,200.0	161,200.0	175,600.0	184,600.0	191,600.0	200,200.0	213,174.3	225,184.0
Total All Information Technology Industries		346,970.9	358,210.6	391,663.2	419,035.1	466,603.8	517,692.8	571,733.7	626,743.6	682,586.9
Share of the Economy (%)		6.1%	6.1%	6.3%	6.4%	6.7%	7.1%	7.5%	7.8%	8.1%
Contribution to Economic Growth (%)			6.24%	11.41%	8.95%	11.14%	14.14%	15.76%	12.38%	14.67%

Sources: Bureau of the Census and Bureau of Economic Analysis for 1990-1995;
Estimates derived for 1996-1998 using Commerce's "U.S. Industry and Trade Outlook."

Note: Value added estimates from various sources (see text)
*GDP as measured by earned income (Gross Domestic Income)

on services—Current Business Report *Service Annual Survey* (latest available for 1995) and the *1992 Census of Service Industries*. The *Service Annual Survey* provides estimated receipts for taxable firms by 4-digit SIC industries. The value added of the software and services IT sector increased from \$59.7 billion in 1990 to \$102.6 billion in 1995.

Value added for software and services is not separately reported so that estimates of value added are derived using the methodology outlined below:

Calculating Receipts Less Cost of Goods Sold—The first part of the value added calculation (receipts less cost of goods sold) for software and services IT industries was derived using the 1990-1995 annual total receipts by industry from the *Service Annual Survey* and subtracting cost of goods sold based on the proportion of cost of goods sold to receipts that existed in 1992.

The *1992 Census of Services Industries* provides a Subject Series called *Sources of Receipts and Revenue* from which the cost of goods sold can be computed. For the software and services IT industries, the cost of goods sold is mostly negligible; i.e., the cost of goods sold for most of these industries was less than 2.0 percent in 1992. Therefore, for these industries, cost of goods sold were made equal to zero. However, there were three software and services IT industries where the cost of goods sold were significant; i.e., exceeded 2.0 percent. They are (1) the computer rental and leasing industry (SIC 7377) where cost of goods sold in 1992 was equal to 8.6 percent of total receipts, (2) the computer maintenance and repair industry (SIC 7378) was 7.6 percent, and (3) the computer services, not elsewhere classified, industry (SIC 7379) was 2.4 percent. Goods sold from these computer services sectors are primarily computers and computer equipment.

Subtracting Purchased Operating Expenses—The *1992 Census of Service Industries* series includes another Subject Series called *Capital Expenditures, Depreciable Assets, and Operating Expenses*. This report lists operating expenses by type and kind of business for payroll, benefits, taxes, depreciation and amortization charges, lease and rental payments, telephone and other purchased communications, purchased utilities, purchased office supplies, and advertising services for 1992. *Purchased* operating expenses include the depreciation charges, utilities, office supplies, and advertising services. Payroll, benefits, and taxes represent value added. Thus the second part of the value added calculation can be made by using the proportion of purchased operating expenses to total receipts for software and services IT industries that existed in 1992 to subtract from the total receipts less cost of goods sold from 1990 through 1995.

Specifically, the proportion of value added to total receipts for software and services IT industries in 1992 are as follows: computer programming services (SIC 7371), 72.6 percent; prepackaged software, (SIC 7372), 66.8 percent; computer

integrated systems design (SIC 7373), 75.8 percent; computer processing and data preparation (SIC 7374), 59.8 percent; information retrieval services (SIC 7375), 71.3 percent; computer services management (SIC 7376), 71.3 percent; computer rental and leasing (SIC 7376), 62.4 percent; computer maintenance and repair (SIC 7378), 63.4 percent, and computer related services, nec (SIC 7379), 68.8 percent.

Value added used for the IT communications services industries were taken directly from BEA's Gross Product Originating (GPO) by industry time series instead of using a calculated value added from the Census data. The value added of the communications services sector increased from \$146.7 billion in 1990 to \$191.6 billion in 1995.

The reasons for using the BEA data are: (1) the BEA industries and the list of industries used in the study matched exactly,²³ (2) the difference from the published BEA value added and the calculated estimates of value added from the revenue and operating expense data from the Bureau of the Census *Annual Survey of Communications Services* was less than one percent for each year between 1990 and 1995, and (3) the BEA data were published; the derived value added data from Census were not. It was felt that a published number prevails over a computed number and that value added should, theoretically, equal GPO.

Value added for wholesale trade of computer equipment and software were added to the list of IT industries, as sales from manufacturers' branch offices are counted by the Census as a wholesale sale and not as a part of manufacturers' shipments. Wholesale sales of computers and equipment increased from \$33.6 billion in 1990 to \$50.8 billion in 1995. Wholesale sales of computer software increased from \$1.7 billion in 1990 to \$2.6 billion in 1995.

The primary source for these data is the Bureau of the Census Current Business Report's Annual Benchmark Report for Wholesale Trade, January 1987 Through February 1997. In this report, gross margins (sales less cost of goods sold) by wholesale industries at the aggregate level are reported. Thus, the first part of the value added calculation (sales less cost of goods sold) is reported directly as gross margins. To take the aggregate reporting to the 4-digit SIC detail needed for this report, additional computations were made:

Computing Gross Margins at 4-Digit SIC Level The annual benchmark report provides gross margins for 3-digit SIC industries only. For purposes of this report, it was necessary to isolate SIC 5045, Wholesale sales of computer equipment and software, which is a subset of SIC 504, Wholesale sales of professional & commercial equipment and supplies. To achieve this, the *1992 Economic Census of Wholesale Trade* was used to derive estimates for value added at the 4-digit SIC level (SIC 5045) and incorporate branch office sales.

In this report, data at the 4-digit SIC level are provided that include sales and purchased operating expenses of all the wholesale sales of computer equipment

and software—from merchant wholesalers, from manufacturers' sales from branch offices, and from wholesale sales from agents, brokers, and commission merchants. In 1992, manufacturer sales of computer equipment and software from their branch offices represented 53 percent of all wholesale sales. These sales are unreported in the annual data. The 1992 benchmark report also provides separate categories of SIC 5045—wholesale sales of computer equipment and wholesale sales of computer software.

Value added at the 4-digit level is calculated using the same proportions of (1) merchant wholesaler sales to manufacturer branch offices' sales over the period and (2) purchased operating expenses (costs of goods sold are already accounted for in the gross margin data) to sales. Gross margin data at the 3-digit level from the annual report are used as controls to derive the 4-digit value added estimates.

Value added for retail trade of computer equipment and software (SIC 5734) were derived in almost the same way as the wholesale estimates. Retail sales of computers and equipment increased from \$1.9 billion in 1990 to \$2.5 billion by 1995. Retail sales of computer software increased from \$93.8 million in 1990 to \$126.1 million by 1995.

In this case, the Bureau of the Census *Annual Benchmark Report for Retail Trade: January 1987 Through December 1996* was used to obtain total sales and gross margins by the aggregate industry category—a combination of SICs 5722, 31, 34 (radio, television and computer stores). The *1992 Census of Retail Trade* was then used to disaggregate the aggregate sector into its parts and provide operating expenses of the industry. The 1992 report also provides sales data on both retail sales of computers equipment and software. The proportions developed for 1992 were then applied to the controls in the remaining years to provide estimates of retail sales at the 4-digit level, much the same way used to derive the estimates of value added for the wholesale IT industries.

The sum of the value added of all the IT industries compared to total nominal GDP²⁴ was used to compute the IT share of the economy. The nominal share of the economy and contribution to nominal economic growth are computed based on GDP, rather than GDI, although GDI would be a more appropriate measure. This was done since (1) GDP is a far more familiar concept than GDI, (2) GDP is thought to be a more accurate measure of the economy, and (3) the difference between the GDP and GDI IT industry share and contribution to growth are small. In 1996, if IT value added were based on GDI, the share of the economy would have been 7.1 percent rather than 7.4 percent (GDP calculation) and the IT contribution to the growth of the economy would have been 13.4 percent instead of 14.5 percent (GDP calculation).

The IT contribution to annual economic growth was calculated simply as the proportion of the annual change in IT industries' total value added over the total annual change in GDP. In 1990, value added of the IT sector was \$347.0 billion or 6.0 percent of total GDP. In 1995, value added of the IT sector was \$517.7 billion, accounting for 7.1 percent of total GDP, and 16.1

percent of total economic growth.

VALUE ADDED OF IT INDUSTRIES, ESTIMATES FOR 1996-98

In order to provide for more recent measurement of value added for IT industries, estimates were made based on projections of industry shipments provided in the “*U.S. Industry and Trade Outlook, ‘98*” (Outlook) jointly published by the Department of Commerce and DRI/McGraw-Hill. For each of the IT industries, estimates of shipments (sales), revenue, or receipts were taken directly or derived (for some IT industries, aggregate industry projections needed to be disaggregated to the IT level of industry detail) from the Outlook report.

To arrive at the value added for the IT industries for 1996 through 1998, the projected shipments (from the Outlook) were multiplied by the average ratio of value added to either sales, revenue, or receipts, from the 1990 through 1995 value added data. In 1996, total value added of the IT sector was \$571.1 billion, 7.5 percent of total GDP, and accounted for 14.6 percent of economic growth. In 1998, it is estimated that total value added of the IT sector will be \$682.6 billion, account for 8.2 percent of total GDP, and account for 14.9 percent of total economic growth.

VALUE ADDED OF IT INDUSTRIES IN REAL 1992 CHAIN WEIGHTED DOLLARS

Nominal value added for IT industries were deflated to constant 1992 chain weighted dollars by using deflators calculated from BEA’s published time series on GPO by industry (Table 8). Deflators were calculated by dividing the nominal dollar GPO by the constant dollar GPO for the appropriate industries in the IT sector. Deflators for computer manufacturing were provided separately. Nominal dollar value added of computer manufacturing was deflated using BEA’s quality-adjusted “hedonic” regression deflators. The regressions relate prices of computer and peripheral equipment models to characteristics of those models, selected to represent factors related to the cost of producing the models. The resulting implicit chain-type deflators for computers and equipment (SIC 3571, 72, 75, 77) used in calculating the real value added of computers were:

<u>Year</u>	<u>Deflator</u>
1990	1.353
1991	1.203
1992	1.000
1993	0.839
1994	0.750
1995	0.593
1996	0.418

**Table 8. Information Technology Industries:
Real Value Added**

Industry		1990	1991	1992	1993	1994	1995	1996
SIC		(Value Added: millions of chained 1992\$)						
Total Gross Domestic Income (GDI)		6,117,800.0	6,069,100.0	6,199,700.0	6,338,200.0	6,596,800.0	6,768,700.0	6,982,700.0
Year-to-Year GDI Change (%)			-0.80%	2.15%	2.23%	4.08%	2.61%	3.16%
Hardware								
Computers and equipment	3571,2,5,7	21,148.1	20,857.1	26,630.8	32,111.6	41,802.1	55,533.2	88,884.2
Computers and equipment wholesale sales	5045 pt	32,985.9	35,111.5	39,465.0	41,595.9	41,456.2	47,937.4	58,349.3
Computers and equipment retail sales	5734 pt	2,015.4	1,949.4	1,915.3	1,970.6	2,447.8	2,454.3	2,753.7
Calculating and office machines, nec	3578,9	2,503.9	2,281.1	2,613.3	2,846.1	3,022.7	3,507.2	3,931.1
Electron tubes	3671	1,284.5	1,104.5	1,280.6	1,172.5	1,489.1	1,930.2	2,332.1
Printed circuit boards	3672	4,871.0	3,363.2	4,348.3	4,294.4	5,531.2	7,493.8	9,854.3
Semiconductors	3674	17,404.2	19,679.6	22,299.7	27,320.3	39,787.5	67,189.1	87,577.9
Passive electronic components	3675-9	12,768.7	13,597.1	16,485.0	16,591.1	20,225.1	25,026.3	33,425.1
Industrial instruments for measurement	3823	4,233.3	4,000.1	4,182.9	4,054.7	4,246.7	4,284.3	3,764.0
Instruments for measuring electricity	3825	6,018.7	5,795.2	5,721.1	5,352.3	6,184.5	6,438.9	5,687.3
Laboratory analytical instruments	3826	3,394.5	3,329.1	3,004.8	3,211.6	3,366.6	3,660.4	3,133.6
Total Hardware		108,628.2	111,067.9	127,946.8	140,521.1	169,559.5	225,455.1	299,692.6
Software and Services								
Total software and services	7371-9 5045 pt 5734 pt	64,905.5	68,142.8	74,435.0	78,219.1	86,628.4	98,252.4	108,586.5
Total Hardware, Software and Services		173,533.7	179,210.7	202,381.8	218,740.2	256,187.9	323,707.5	408,279.1
Communications								
Communications Hardware	3651, 61 63, 95	23,847.3	23,363.4	29,081.6	31,459.8	39,868.9	52,310.3	68,019.4
Telephone and telegraph communications	481,22, 99	120,595.4	125,101.1	129,700.0	133,598.0	137,894.2	136,393.8	141,198.6
Broadcasting and cable TV services	4832	28,600.0	31,500.0	31,500.0	38,100.0	38,800.0	41,700.0	40,400.0
Total Communications Services		149,195.4	156,601.1	161,200.0	171,698.0	176,694.2	178,093.8	181,598.6
Total Communications		173,042.7	179,964.5	190,281.6	203,157.8	216,563.1	230,404.1	249,618.0
Total All Information Technology Industries		346,576.4	359,175.2	392,663.4	421,898.0	472,751.0	554,111.6	657,897.1

Source: DOC's Economics and Statistics Administration estimates

The hedonic deflators for computers were not used to calculate the wholesale and retail trade of computer equipment and software. Instead, the wholesale trade and retail trade implicit deflators were used since these industries consist primarily of the wholesale and retail distribution network. The BEA also publishes quality-adjusted price indexes for semiconductors.²⁵ However, to be conservative, the implicit GPO deflator for “Electronic and other Electric Equipment” was used for semiconductors. The following implicit GPO deflators were also used for the remaining IT industries: communications services deflator for the communications services industries; the electronic and electric equipment deflator for the communications equipment industries; the business services deflator for the software and services industries; the electronic and other electric equipment deflator for the IT electronics components industries; and the instruments and related products deflator for the IT instrument industries.

IT contribution to real economic growth was computed using a methodology described in detail in BEA’s May 1997 *Survey of Current Business* article called “BEA’s Chain Indexes, Time Series, and Measures of Long-Term Economic Growth” by J. Steven Landefeld and Robert P. Parker. The box on page 63 provides a “Note on Computing Alternative Chained Dollar Indexes and Contributions to Growth.”

The methodology to compute real chain weighted dollar contribution to economic growth is not the same straight forward process used in determining contribution to growth for nominal dollars or if the real dollars would have been fixed. Basically, the chain-type weights require that growth from year-to-year for each of the IT industries’ value added be rebased by moving the nominal value added for each of the industries by the change in the real value added. This basically sets each of the years as the base, or equal to 100, so that the difference between the nominal base and the calculated change is equal to the growth of IT industries.

The rebased growth of IT industries was calculated in two ways and then averaged. First, growth for one year, say 1995, is based on the change in real growth (from the rebased nominal for 1995) to the next year, 1996. In this study, this is called the “next year” method. The changes in real growth from year-to-year, rebasing coefficients, are multiplied by the nominal value added (rebased so that each year equals 100.0) for each of the IT industries. The change from the nominal to the rebased change is the calculated change in the real. Second, growth for 1995 is also calculated on the change in real growth (again from the rebased nominal 1995) from the prior year, 1994. In this study, this is called the “prior year” method. The change in IT industries for both of these methods are averaged to derive a rebased change in IT industries for each of the years (Table 9). The contribution to real economic growth is then calculated as the total average change in the rebased IT industries over the annual change in real GDI (Table 10).

Table 9: Information Technology Industries:
Average Annual Real Growth
(Prior Year and Next Year Method)
(Millions of Rebased 92\$)

Industry	199119921993199419951996							199119921993199419951996						199119921993199419951996					
	SIC	(Change in IT Components--Prior Year)						(Change in IT Components--Next Year)						(Change in IT Components--Average)					
Hardware																			
Computers and equipment	3571,2,5,7	-394.6	6,945.8	5,480.8	8,130.3	10,298.3	19,777.2	-350.1	5,773.7	4,598.4	7,267.9	8,142.5	13,940.7	-372.3	6,359.7	5,039.6	7,699.1	9,220.4	16,858.9
Computers and equipment wholesale sales	5045 pt	2,165.1	4,432.3	2,130.9	-142.0	6,761.5	11,024.1	2,164.1	4,353.5	2,165.7	-145.7	6,862.3	10,907.9	2,164.6	4,392.9	2,148.3	-143.9	6,811.9	10,966.0
Computers and equipment retail sales	5734 pt	-60.8	-33.0	55.3	483.1	6.7	306.7	-63.9	-34.1	56.0	488.4	6.7	308.4	-62.4	-33.6	55.6	485.7	6.7	307.5
Calculating and office machines, nec	3578,9	-231.9	338.9	232.8	170.2	450.6	367.0	-227.3	332.2	224.3	164.2	419.4	342.1	-229.6	335.6	228.6	167.2	435.0	354.6
Electron Tubes	3671	-184.7	180.3	-108.1	306.7	402.1	306.7	-184.3	176.1	-104.7	288.6	336.6	265.9	-184.5	178.2	-106.4	297.6	369.3	286.3
Printed circuit boards	3672	-1,546.9	1,008.7	-53.9	1,198.1	1,788.9	1,801.3	-1,544.0	985.1	-52.2	1,127.3	1,497.7	1,561.5	-1,545.4	996.9	-53.1	1,162.7	1,643.3	1,681.4
Semiconductors	3674	2,334.3	2,683.0	5,020.6	12,077.0	24,976.6	15,558.7	2,330.0	2,620.1	4,863.5	11,363.9	20,910.2	13,487.2	2,332.2	2,651.5	4,942.0	11,720.4	22,943.4	14,522.9
Passive electronic components	3675-9	849.9	2,957.2	106.1	3,520.3	4,376.3	6,409.1	848.3	2,887.9	102.8	3,312.4	3,663.8	5,555.8	849.1	2,922.6	104.4	3,416.3	4,020.1	5,982.5
Industrial instruments for measurement	3823	-207.4	172.1	-128.2	200.7	40.6	-607.0	-219.5	182.8	-134.0	207.3	43.9	-710.5	-213.5	177.4	-131.1	204.0	42.2	-658.7
Instruments for measuring electricity	3825	-198.8	-69.8	-368.8	869.8	274.7	-876.9	-210.4	-74.1	-385.5	898.6	296.8	-1,026.3	-204.6	-71.9	-377.1	884.2	285.8	-951.6
Laboratory analytical instruments	3826	-58.2	-305.3	206.8	162.0	317.2	-614.6	-61.6	-324.3	216.1	167.4	342.8	-719.3	-59.9	-314.8	211.5	164.7	330.0	-667.0
Total Hardware																			
Software and Services																			
Total software and services	7371-9 5045 pt 5734 pt	2,975.7	5,912.2	3,733.3	8,384.1	12,042.5	10,790.9	3,041.8	6,207.7	3,772.7	8,712.0	12,137.8	11,130.9	3,008.7	6,059.9	3,753.0	8,548.1	12,090.1	10,960.9
Services																			
Communications																			
Total Communications Hardware	3651, 61 63, 95	-496.4	5,855.4	2,378.2	8,145.9	11,340.3	11,987.6	-495.5	5,718.2	2,303.8	7,664.9	9,494.0	10,391.4	-496.0	5,786.8	2,341.0	7,905.4	10,417.2	11,189.5
Telephone and telegraph communications	481,22, 99	4,449.8	4,547.4	3,898.0	4,328.4	-1,546.2	5,076.3	4,455.2	4,598.9	3,927.2	4,427.2	-1,585.2	5,090.7	4,452.5	4,573.1	3,912.6	4,377.8	-1,565.7	5,083.5
Broadcasting and cable TV services	4832	2,798.6	0.0	6,600.0	753.3	3,176.5	-1,480.8	2,807.9	0.0	7,102.4	766.8	3,303.4	-1,628.2	2,803.3	0.0	6,851.2	760.0	3,240.0	-1,554.5
Total Communications Services																			
Total Communications																			
Sum of the Average IT Industries Year-to-Year Changes														12,242.2	34,014.4	28,920.1	47,649.5	70,289.6	74,362.1

Source: DOC's Economics and Statistics Administration estimates based on DOL's Bureau of Labor Statistics data

**Table 10. IT Contribution
To Real Economic Growth**
(billions of 92\$)

<u>Year</u>	<u>Real GDI</u>	<u>Change</u>	<u>Real IT</u>	<u>Change In IT*</u>	<u>Contribution To Real Growth</u>
1990	6,117.8		346.6		
1991	6,069.1	-48.7	359.2	12.2	n.a.
1992	6,199.7	130.6	392.7	34.0	26.0%
1993	6,338.2	138.5	421.9	28.9	20.9%
1994	6,596.8	258.6	472.8	47.6	18.4%
1995	6,768.2	171.4	554.1	70.3	41.0%
1996	6,982.7	214.5	657.9	74.4	34.7%
1997	7,248.0	265.3	775.4	75.2	28.3%**
* Calculated based on method described in text.					
** Estimated for real GDI and real IT					

Total GDI and price deflators for IT industries are not yet available for 1997, therefore, real GDI was estimated based on the 3.8 percent real growth in GDP, which is available. Real value added for IT industries for 1997 was estimated based on the relationship between nominal IT and calculated real IT for 1996.

IT CONTRIBUTION TO LOWERING INFLATION

Since GDI was used in this analysis to calculate the contribution to real economic growth, overall inflation was calculated from the implicit price deflator for GDI; i.e., an overall price index calculated as nominal GDI over real GDI (Table 11).

The year-to-year change in the index is the annual change in overall prices as measured by the index. Nominal and real value added of IT industries are subtracted from total nominal and real GDI. The index and the year-to-year change in the index are recalculated to determine the overall inflation rate, using the implicit deflator for GDI, without the value added of IT industries.

**Table 11. IT Industries Contribution
To Lowering Overall Inflation**

Total Gross Domestic Income (GDI)				
<u>Year</u>	<u>Nominal</u>	<u>Real*</u>	<u>Index</u>	<u>Change</u>
	(\$billions)			
1990	5,726.4	6,117.8	0.936	
1991	5,906.6	6,069.1	0.973	4.0%
1992	6,199.7	6,199.7	1.000	2.8%
1993	6,505.5	6,338.2	1.026	2.6%
1994	6,932.4	6,596.8	1.051	2.4%
1995	7,293.6	6,768.2	1.078	2.6%
1996	7,636.0	6,982.7	1.094	1.5%
1997**	8,081.0	7,248.0	1.115	2.0%
Total GDI, less IT Industries				
1990	5,379.4	5,771.2	0.932	
1991	5,548.4	5,709.9	0.972	4.3%
1992	5,807.0	5,807.0	1.000	2.9%
1993	6,086.5	5,916.3	1.029	2.9%
1994	6,465.8	6,124.0	1.056	2.6%
1995	6,775.9	6,214.1	1.090	3.3%
1996	7,064.3	6,424.8	1.117	2.4%
1997**	7,454.3	6,472.6	1.152	3.1%
*1992 = 100		** Estimate		

IT EQUIPMENT INVESTMENT AND NET CAPITAL STOCK

BEA produces annual estimates of investment flows and capital stock by industry and by type of asset. BEA defines information processing equipment (IT equipment) to include: office, computing, and accounting machinery, communications equipment, photocopy and related equipment, and instruments. Estimates of IT equipment spending as a share of total business equipment spending were derived from inflation-adjusted investment expenditures on the above assets. BEA recently developed a new, chain-weighted deflation method which is preferable to the fixed-weighted deflators previously used because they allow for changes in prices and output

composition over time.²⁶ However, chain-weighted estimates are not additive and it would be misleading to use the IT capital spending share to approximate a non-IT capital spending share. Also, BEA warns that chain-weighted estimates may lose some accuracy as one moves away from the base period and thus, may not be suitable for time series analysis.

Industries that were considered heavy users of IT equipment were determined in two ways—the level of overall use of IT equipment relative to total equipment use and their IT investment per employee. (Tables 12 and 13) Fifty-three industries (exc. farming) were ranked according to both measures of IT intensity and the top 15 industries were designated as “major users” of information technology.

Net capital stock is the cumulative value of past gross investment less the cumulative value of past depreciation. Total net capital stock of equipment includes non-IT industrial equipment, transportation equipment, etc. in \$1987. Investment in IT equipment per employee includes annual purchases of IT equipment (\$1987) divided by the number of workers in each industry. The most recent investment and net capital stock data by industry and by asset type are for 1994. BEA expects to release data for 1995 and 1996 in the spring of 1998.

EMPLOYMENT TRENDS AND PROJECTIONS

The employment numbers used in this analysis are from the Current Employment Statistics (CES) survey, conducted monthly by the Bureau of Labor Statistics (BLS) in conjunction with state employment security agencies (Table 14). Private employment includes all full and part-time employees except those in the agricultural and government sectors. These data can be found at the BLS website (<http://www.bls.gov>). BLS also collects employment data through the Covered Employment and Wages (ES202) program, which are published annually in *Employment and Wages, Annual Averages*. When CES employment figures were not available at the necessary level of detail (4-digit SIC level), employment levels were estimated by applying the 4-digit SIC level employment distribution of the ES202 numbers to the aggregate (3-digit SIC level) CES numbers. When CES employment numbers were not available at the 3-digit SIC level, ES202 employment numbers were used.

BLS publishes employment projections by industry to 2006, but mainly at the 2- and 3-digit SIC levels. Historical employment trends (1990 to 1996) were used to extrapolate employment demand of 4-digit industries to 2006. Five entire 2- or 3-digit industries were included among our list of IT industries -- computer and office equipment (357), electronic components and accessories (367), communications equipment (366), communications services (48), and computer and data processing services (737). For these industries, the projected employment levels were scaled to match officially published BLS projections. For the remaining industries, the unadjusted extrapolated employment estimates were used.

Estimates of employment by wholesale and retail sellers of computer equipment and software

Table 12. IT Intensity: IT Net Capital Stock Share of Total Equipment Stock, 1994

RANK		IT EQUIPMENT STOCK (bils. \$1987)					SHARE OF TOTAL EQUIPMENT (percent)				
		1990	1991	1992	1993	1994	1990	1991	1992	1993	1994
1	Telephone and telegraph	111.6	108.7	107.1	105.4	108.1	85.9	86.2	86.3	86.3	86.3
2	Insurance agents, brokers, and services	0.9	1.0	1.2	1.4	1.7	75.6	78.2	81.4	84.2	86.0
3	Security and commodity brokers	2.3	2.2	2.2	2.4	2.7	75.0	75.2	76.2	78.3	80.7
4	Holding and other investment offices	4.3	4.1	4.1	4.7	5.2	73.7	73.9	74.9	77.6	79.6
5	Motion pictures	4.3	5.0	5.5	6.2	7.0	69.9	71.0	71.6	72.5	73.7
6	Insurance carriers	21.3	24.4	28.1	33.3	38.8	55.0	57.2	59.7	62.8	65.6
7	Radio and television	17.8	19.4	20.6	22.2	24.0	58.1	59.2	59.5	60.2	61.0
8	Miscellaneous services	8.2	9.2	10.0	12.1	14.8	44.5	47.4	49.7	53.6	57.2
9	Wholesale trade	62.8	67.9	74.7	83.4	95.0	47.9	49.8	51.6	53.8	56.1
10	Legal services	4.5	4.9	5.3	5.7	6.1	49.0	50.8	52.4	54.2	56.0
11	Educational services	0.2	0.3	0.3	0.4	0.4	40.4	43.3	46.2	50.6	55.3
12	Health services	17.4	17.5	17.9	18.4	18.8	50.3	50.9	51.8	52.5	53.1
13	Retail trade	51.1	58.3	68.3	81.1	98.1	37.6	39.7	42.1	44.2	46.2
14	Instruments and related products	7.7	8.4	9.0	9.9	10.4	37.2	39.3	41.1	43.6	45.4
15	Real estate	68.9	71.3	70.4	73.6	80.3	40.6	41.5	42.3	43.4	44.7
16	Local & interurban passenger transport	2.0	1.9	1.7	1.5	1.4	39.7	40.1	40.0	39.7	39.0
17	Personal services	2.3	2.6	3.1	4.0	5.1	27.9	30.2	32.4	35.8	38.7
18	Amusement and recreation services	2.2	2.3	2.3	2.5	2.8	29.6	30.7	31.4	33.1	35.2
19	Chemicals and allied products	21.1	23.8	26.3	28.9	32.1	27.9	29.9	31.5	32.8	34.1
20	Transportation by air	10.7	10.6	12.2	13.4	14.4	25.6	25.9	28.5	30.6	33.4
21	Electronic and other electrical equip.	13.4	14.1	14.3	16.2	18.1	25.3	26.3	26.7	28.8	30.9
22	Hotels and other lodging places	2.7	2.7	2.5	2.4	2.3	26.7	28.0	28.6	29.7	30.6
23	Stone, clay, and glass products	2.7	2.9	3.1	4.0	4.9	17.7	19.4	21.2	25.6	29.7
24	Commercial and mutual depository inst.	33.9	35.0	38.3	44.2	52.2	22.3	22.6	23.9	26.2	29.2
25	Industrial machinery and equipment	10.5	11.4	12.4	15.4	20.4	17.4	18.7	20.2	23.9	29.1
26	Railroad transportation	5.6	5.8	5.9	6.2	6.7	20.9	22.5	24.0	25.7	27.8
27	Printing and publishing	3.7	4.2	4.6	5.6	6.9	16.9	18.4	19.9	22.8	26.1
28	Misc. repair services	0.5	0.6	0.8	1.2	1.7	11.3	13.3	16.0	20.6	25.0
29	Pipelines, except natural gas	0.0	0.0	0.0	0.0	0.1	19.1	20.5	21.3	22.9	23.6
30	Petroleum and coal products	3.1	4.1	4.7	5.3	5.7	13.3	16.2	18.0	19.6	20.8
31	Business services	13.9	14.1	15.4	18.6	24.4	13.9	14.0	15.0	17.0	20.4
32	Lumber and wood products	1.3	1.3	1.3	1.5	1.6	15.5	16.7	17.7	18.9	20.1
33	Furniture and fixtures	0.4	0.5	0.5	0.6	0.8	12.5	13.3	14.4	17.1	20.1
34	Auto repair, services, and parking	13.1	14.0	14.1	15.2	17.5	17.5	18.3	17.9	18.6	20.0
35	Nondepository credit institutions	5.7	6.5	7.9	10.6	13.9	11.0	12.2	13.9	16.9	20.0
36	Electric, gas, and sanitary services	29.1	30.9	33.4	35.9	39.2	15.5	16.3	17.4	18.4	19.3
37	Other transportation equipment	2.9	3.0	3.1	3.7	4.8	12.5	13.1	13.7	15.9	19.0
38	Leather and leather products	0.1	0.1	0.1	0.1	0.1	9.5	10.5	11.8	14.4	17.1
39	Water transportation	1.2	1.4	1.6	2.1	2.4	7.1	8.4	10.6	13.9	17.0
40	Food and kindred products	5.2	6.2	7.2	8.4	10.1	11.2	12.5	13.8	15.0	16.4
41	Mining	8.7	8.3	7.7	7.5	7.5	14.5	15.0	15.2	15.7	16.3
42	Textile mill products	1.6	1.7	1.7	1.9	2.0	11.9	12.9	13.8	14.8	15.8
43	Tobacco manufactures	0.5	0.5	0.5	0.5	0.4	15.4	16.1	15.9	15.8	15.5
44	Misc. manufacturing industries	0.3	0.4	0.4	0.5	0.7	7.8	9.0	10.2	12.2	14.3
45	Construction	3.4	3.6	3.8	3.9	4.2	10.4	11.2	12.1	12.7	13.4
46	Rubber and misc. plastics products	1.6	1.8	1.9	2.2	2.7	8.3	9.0	9.6	10.6	12.3
47	Motor vehicles and equipment	2.2	2.5	2.8	3.8	5.4	6.3	7.2	7.8	9.8	12.2
48	Primary metal industries	3.9	4.2	4.7	5.3	6.2	6.7	7.4	8.3	9.3	10.7
49	Fabricated metal products	2.1	2.2	2.1	2.3	2.8	5.5	5.9	6.0	6.7	7.8
50	Paper and allied products	2.7	3.0	3.2	3.6	4.3	5.1	5.6	5.9	6.6	7.5
51	Transportation services	1.1	1.0	1.0	1.0	1.0	6.5	6.3	6.2	6.3	6.4
52	Trucking and warehousing	1.6	1.5	1.4	1.4	1.4	4.6	4.9	5.0	5.1	5.2
53	Apparel and other textile products	0.1	0.1	0.1	0.1	0.1	3.0	3.2	3.4	3.5	3.3
All Nonfarm Private Industries		\$604.5	\$638.0	\$678.6	\$747.7	\$847.0	27.4	28.6	29.9	31.7	33.7

Source: Bureau of Economic Analysis

Table 13. IT Intensity: IT Investment per Employee, 1994

Rank	\$1987	1990	1991	1992	1993	1994
1	Telephone and telegraph	\$14,084	\$13,710	\$15,429	\$15,082	\$19,441
2	Real estate	8,843	10,167	8,018	11,175	13,890
3	Radio and television	12,728	10,961	10,173	11,900	12,726
4	Nondepository institutions	4,431	5,941	8,010	10,692	12,458
5	Electric, gas, sanitary	8,005	6,782	7,987	8,663	10,427
6	Petroleum and coal products	6,290	10,081	8,826	9,762	9,557
7	Commercial and mutual depository institutions	4,275	3,912	5,456	7,240	9,056
8	Insurance carriers	4,704	5,560	6,593	8,099	8,927
9	Holding and other investment offices	3,398	3,394	4,621	7,224	7,616
10	Chemicals and allied products	4,477	5,896	6,003	6,382	7,522
11	Auto repair, services, and parking	2,990	4,211	3,498	4,517	5,943
12	Railroad transportation	3,216	3,210	3,177	4,056	5,385
13	Motion pictures	2,924	3,828	3,682	4,478	4,893
14	Industrial machinery and equipment	1,744	1,801	2,085	3,306	4,652
15	Wholesale trade	2,320	2,583	3,082	3,648	4,308
16	Stone, clay, and glass products	1,534	1,553	1,798	3,244	3,728
17	Water transportation	1,772	1,683	2,660	3,936	3,660
18	Electronic and other electric equipment	1,998	1,896	1,792	3,008	3,145
19	Transportation by air	2,202	1,372	3,407	3,065	3,032
20	Primary metal industries	1,333	1,568	1,814	2,186	2,793
21	Instruments and related products	1,802	2,100	2,168	2,715	2,691
22	Motor vehicles and equipment	815	955	905	1,941	2,645
23	Miscellaneous repair services	387	748	1,066	1,759	2,354
24	Mining	1,525	1,730	1,364	2,016	2,321
25	Food and kindred products	900	1,264	1,378	1,619	2,078
26	Paper and allied products	1,404	1,240	1,113	1,505	2,074
27	Personal services	623	838	1,020	1,499	1,887
28	Printing and publishing	923	902	1,012	1,480	1,861
29	Legal services	1,753	1,418	1,503	1,573	1,763
30	Business services	580	703	924	1,264	1,696
31	Security and commodity brokers	842	882	1,061	1,510	1,639
32	Retail trade	548	780	986	1,193	1,458
33	Tobacco manufactures	1,405	2,265	1,326	1,465	1,235
34	Other transportation equipment	396	402	437	778	1,122
35	Rubber and miscellaneous plastics products	522	546	564	701	1,090
36	Hotels and other lodging	367	281	130	199	1,058
37	Insurance agents, brokers, and services	327	452	623	828	929
38	Miscellaneous services	361	417	416	616	764
39	Transportation services	562	669	671	734	741
40	Pipelines, except natural gas	216	474	573	652	702
41	Fabricated metal products	416	398	333	526	696
42	Miscellaneous manufacturing industries	274	339	392	550	692
43	Textile mill products	548	494	478	627	656
44	Furniture and fixtures	289	261	312	528	626
45	Amusement and recreation services	396	423	354	477	584
46	Lumber and wood products	372	327	284	491	554
47	Health services	437	352	366	393	381
48	Leather and leather products	158	154	192	299	363
49	Local and interurban passenger transportation	518	297	66	148	205
50	Construction	122	155	156	146	189
51	Trucking and warehousing	151	113	111	128	159
52	Educational services	42	50	57	78	89
53	Apparel and other textile products	26	20	22	20	10
Average Nonfarm Private Industries		\$1.400	\$1.525	\$1.690	\$2.080	\$2.500

Sources: Bureau of Economic Analysis and Bureau of Labor Statistics

**Table 14. Information Technology Industries:
Employment Trends and Projections, 1985 to 1996 and 2006**

Industry	SIC	1985	1990	1991	1992	1993	1994	1995	1996	2006*	Change 1985-1996	AAG 1985-1996 (Percent)	Change 1996-2006	AAG 1996-2006 (Percent)
Total Private Employment		80,992	91,098	89,847	89,956	91,872	95,036	97,885	100,076	115,168	19,084	1.9	15,092	1.4
Year to Year Change in Employment				-1.4%	0.1%	2.1%	3.4%	3.0%	2.2%					
Hardware														
Electronic computers	3571	325.5	278.5	258.8	241.9	216.1	201.1	190.0	189.5	105.6	-136.0	-4.8	-83.9	-5.7
Computers and equipment wholesalers	5045pt.	273.2	294.9	295.5	277.6	270.9	271.8	285.7	301.0	281.5	27.8	0.9	-19.4	-0.7
Computers and equipment retailers	5734pt.	54.1	71.3	72.1	75.4	78.2	84.5	93.7	103.6	185.5	49.5	6.1	81.9	6.0
Computer storage devices & peripheral equipment	3572,7	98.3	94.3	94.3	91.3	93.2	97.9	104.5	115.3	157.6	17.0	1.5	42.3	3.2
Computer terminals, office and accounting machines, and office machines, n.e.c.	3575,8,9	76.4	64.8	62.2	57.8	54.1	55.2	57.7	58.2	50.8	-18.2	-2.4	-7.4	-1.3
Electron tubes	3671	46.9	31.9	28.8	26.9	24.8	24.5	24.0	23.0	15.4	-23.9	-6.3	-7.6	-3.9
Semiconductors	3674	279.1	239.6	231.6	217.4	213.8	220.5	235.2	256.1	280.4	-23.0	-0.8	24.3	0.9
Printed circuit boards, electronic capacitors, resistors, coils, transformers, and connectors	3672,5-8	170.8	169.4	161.0	156.6	161.6	168.2	187.0	194.3	262.4	23.5	1.2	68.1	3.1
Electronic components, n.e.c.	3679	149.8	141.4	133.4	126.5	127.5	131.0	134.6	136.6	141.8	-13.2	-0.8	5.2	0.4
Industrial instruments for measurement	3823	58.1	66.6	63.1	61.0	60.5	62.0	64.2	66.2	64.3	8.1	1.2	-1.9	-0.3
Instruments for measuring electricity	3825	109.0	91.0	84.2	76.1	72.8	71.2	71.2	75.0	48.8	-34.0	-3.3	-26.2	-4.2
Analytical instruments	3826	25.0	30.0	28.1	28.1	28.1	26.9	28.1	31.1	29.5	6.1	2.0	-1.6	-0.5
Total Hardware		1,666.2	1,573.6	1,513.1	1,436.6	1,401.6	1,414.8	1,475.9	1,549.8	1,623.7	-116.4	-0.7	73.8	0.5
Software/Services														
Computer programming services	7371	79.0	150.8	156.9	168.6	188.3	209.9	245.3	271.9	708.1	192.9	11.9	436.2	10.0
Prepackaged software	7372	55.0	112.8	124.4	130.8	144.8	157.4	180.8	198.9	476.4	143.9	12.4	277.5	9.1
Prepackaged software wholesalers	5045pt.	13.8	14.9	14.9	14.0	13.7	13.7	14.4	15.2	14.2	1.4	0.9	-1.0	-0.7
Prepackaged software retailers	5734pt.	2.7	3.6	3.6	3.8	4.0	4.3	4.7	5.2	9.4	2.5	6.2	4.1	6.0
Computer integrated systems design	7373	60.0	97.5	98.7	102.5	109.5	116.4	129.9	142.4	244.5	82.4	8.2	102.1	5.6
Computer processing and data preparation	7374	192.0	196.7	198.2	204.4	207.3	209.5	223.1	231.3	268.8	39.3	1.7	37.5	1.5
Information retrieval services	7375	39.0	47.7	45.2	45.2	46.2	48.0	56.9	68.4	98.0	29.4	5.2	29.6	3.7
Computer services management, rental and leasing, and maintenance and repair	7376,7,9	91.0	126.6	131.1	141.2	154.9	172.9	205.3	242.4	643.9	151.4	9.3	401.5	10.3
Computer maintenance and repair	7378	25.0	39.8	42.5	42.8	41.8	44.5	48.6	52.6	69.3	27.6	7.0	16.7	2.8
Total Software/Services		557.5	790.4	815.6	853.3	910.4	976.6	1,109.1	1,228.3	2,532.6	670.8	7.4	1,304.9	7.5
Communications Equipment														
Household audio and video equipment	3651	65.7	62.4	61.2	59.8	59.5	59.9	55.7	54.9	45.3	-10.8	-1.6	-9.6	-1.9
Household audio and video equip. retailers	5731	110.8	116.6	119.1	120.1	128.4	148.2	166.2	181.1	382.9	70.3	4.6	201.8	7.8
Telephone and telegraph equipment	3661	169.0	126.3	116.7	109.6	110.0	109.5	111.7	112.6	79.0	-56.4	-3.6	-33.6	-3.5
Radio and TV communications equipment and communications equipment, n.e.c.	3663,9	148.0	137.2	134.4	128.9	129.0	138.3	153.2	156.6	176.0	8.6	0.5	19.4	1.2
Magnetic and optical recording media	3695	20.0	18.9	20.0	18.3	18.2	18.8	16.7	17.0	13.5	-3.0	-1.5	-3.5	-2.3
Total Communications Equipment		513.5	461.4	451.4	436.7	445.1	474.7	503.5	522.2	696.7	8.7	0.2	174.5	2.9
Communications Services														
Telephone communications	481	920.7	913.0	909.2	885.2	879.0	893.4	899.7	897.7	834.7	-23.0	-0.2	-63.0	-0.7
Telephone and telegraph communications	482,489	51.8	36.6	31.5	25.6	24.4	24.7	26.7	25.8	13.3	-26.0	-6.1	-12.5	-6.4
Radio broadcasting	4832	113.0	118.8	116.5	112.9	113.3	113.5	113.0	114.6	101.6	1.6	0.1	-13.0	-1.2
Television broadcasting	4833	115.4	114.7	113.6	114.6	116.2	118.7	122.7	128.3	145.8	12.9	1.0	17.5	1.3
Cable and other pay TV services	4841	117.9	125.8	128.0	130.6	136.2	144.5	155.5	171.1	264.6	53.2	3.4	93.5	4.5
Total Communications Services		1,318.8	1,308.9	1,298.8	1,268.9	1,269.1	1,294.8	1,317.6	1,337.5	1,360.0	18.7	0.1	22.5	0.2
Total IT-Producing Industries		4,056.0	4,134.3	4,078.8	3,995.5	4,026.3	4,161.0	4,406.1	4,637.9	6,212.9	582	1.2	1,575.0	3.0
Share of Total Employment		5.0%	4.5%	4.5%	4.4%	4.4%	4.4%	4.5%	4.6%	5.4%				
Contribution to Employment Growth		(percentage point)		-0.1	-0.1	0.0	0.1	0.3	0.2					

* ESA estimates based on BLS projections.
Source: Bureau of Labor Statistics

(SICs 5045 and 5734) were divided among the hardware and software/services categories using the same distribution as value added -- 95 percent to hardware and 5 percent to software/services. The contribution to employment growth was estimated by computing the ratio of the annual change in IT industry employment to the change in total private employment and applying that ratio to the annual percent change in total private employment.

TOTAL WAGES AND EARNINGS PER WORKER IN IT INDUSTRIES

Total wages are collected as part of the BLS ES202 program and include gross wages and salaries, bonuses, stock options, tips and other gratuities and in some cases the value of meals and lodging (Table 15).²⁷ Wage projections are not available.

Average annual earnings per employee were computed using the employment and wage data described above (Table 16). Note that these simple averages are for purposes of comparing relative wages across industries and should not be interpreted as official BLS estimates of median earnings. Estimates of earnings per worker include all occupations in each industry and should not be interpreted as average earnings for specific occupations.

IT-RELATED OCCUPATIONS

Occupations considered to be IT-related were first selected from the BLS occupation classification system (Table 6). Then, these IT-related occupations were reviewed by the BLS and others. Occupations considered to be essential to IT and to electronic commerce were maintained. Other occupations were deleted from the category.

The primary sources for the number of employees in each occupation in each industry were from the BLS *National Industry-Occupation Matrix 1983-95 Time Series* and the 1996 to 2006 projections in the *Occupational Outlook Handbook (Handbook)*. The mean wage for each occupation is from the OES website (http://stats.bls.gov/oes/national/oes_nat.htm). The mean hourly wage was used to compute an annual average wage of all employees with IT occupations. Employees with IT occupations were counted across all industries, including Government (Tables 17 and 18). A net employment estimate and an average mean wage for all IT workers was derived by combining employment and wages of IT industries with employment and wages of workers with IT occupations, being careful not to double count workers with IT occupations in IT industries (Table 19).

Table 15. Information Technology Industries: Wage Growth, 1985 to 1996

		1985	1990	1991	1992	1993	1994	1995	1996	Change 1985-1996
		(\$millions)								
All Private Industries		\$1,526.164	\$2,114.282	\$2,152.022	\$2,282.598	\$2,365.301	\$2,494.459	\$2,658.927	\$2,837.335	\$1,311.171
IT Industries		\$112.627	\$149.859	\$154.101	\$162.394	\$168.222	\$179.301	\$200.123	\$224.883	\$112.256
IT Share of Total		7.4%	7.1%	7.2%	7.1%	7.1%	7.2%	7.5%	7.9%	
Hardware										
Electronic computers	3571	10,640	12,924	12,577	12,666	11,811	11,187	11,317	11,821	1,181
Computer and equipment wholesalers	5045pt.	9,537	13,658	14,550	14,572	14,343	14,373	15,513	17,318	7,781
Computer and equipment retailers	5734pt.	1,108	2,071	2,243	2,431	2,389	2,710	3,164	3,585	2,477
Computer storage devices & peripheral equipment	3572,7	2,764	3,389	3,678	3,761	3,975	4,200	4,861	5,823	3,059
Computer terminals, office and accounting machines, and office machines, n.e.c.	3575,8,9	2,196	2,544	2,566	2,500	2,424	2,447	2,687	2,883	688
Electron tubes	3671	1,257	1,029	991	1,032	932	974	1,005	938	-320
Semiconductors	3674	7,872	9,131	9,390	9,670	10,126	10,923	12,654	14,124	6,251
Printed circuit boards, electronic capacitors, resistors, coils, transformers, and connectors	3672,5-8	3,152	4,101	4,062	4,023	4,276	4,622	5,291	5,754	2,603
Electronic components, n.e.c.	3679	3,261	3,825	3,847	3,759	3,908	4,185	4,430	4,695	1,434
Industrial instruments for measurement	3823	1,425	2,111	2,082	2,140	2,168	2,297	2,467	2,679	1,254
Instruments for measuring electricity	3825	2,906	3,349	3,334	3,234	3,202	3,431	3,671	4,052	1,146
Laboratory analytical instruments	3826	699	1,032	1,009	1,088	1,102	1,147	1,243	1,484	785
Total Hardware		\$46.817	\$59.164	\$60.328	\$60.876	\$60.656	\$62.496	\$68.303	\$75.156	\$28.339
Share of Total		3.1%	2.8%	2.8%	2.7%	2.6%	2.5%	2.6%	2.6%	
Software/Services										
Computer programming services	7371	2,316	6,312	6,755	7,793	8,954	10,507	12,935	15,721	13,405
Prepackaged software	7372	1,811	5,133	6,147	7,455	7,890	8,968	11,517	14,086	12,275
Prepackaged software wholesalers	5045pt.	482	690	735	736	725	726	784	875	393
Prepackaged software retailers	5734pt.	56	105	113	123	121	137	160	181	125
Computer integrated systems design	7373	1,894	4,270	4,406	4,977	5,441	6,140	7,107	8,517	6,623
Computer processing and data preparation	7374	4,460	5,990	6,099	7,026	7,490	7,673	8,868	9,968	5,509
Information retrieval services	7375	980	1,560	1,584	1,659	1,797	1,852	2,401	3,181	2,201
Computer services management, rental and leasing, and maintenance and repair	7376,7,9	2,761	5,214	5,669	6,491	7,254	8,459	10,640	13,853	11,092
Computer maintenance and repair	7378	673	1,365	1,448	1,566	1,567	1,657	1,838	2,108	1,435
Total Software/Services		\$15.433	\$30.639	\$32.957	\$37.826	\$41.239	\$46.119	\$56.250	\$68.490	\$53.057
Share of Total		1.0%	1.4%	1.5%	1.7%	1.7%	1.8%	2.1%	2.4%	
Communications Equipment										
Household audio and video equipment	3651	1,766	1,806	1,890	1,955	2,015	2,210	1,803	1,924	157
Household audio and video equipment retailers	5731	1,395	2,112	2,246	2,393	2,491	2,971	3,370	3,662	2,267
Telephone and telegraph equipment	3661	4,779	4,698	4,471	4,645	4,994	5,129	5,574	6,256	1,477
Radio and TV communications equipment and communications equipment, n.e.c.	3663,9	3,940	4,729	4,769	5,037	5,202	5,541	6,547	6,917	2,977
Magnetic and optical recording media	3695	401	587	664	685	706	741	656	770	368
Total Communications Equipment		\$12.282	\$13.932	\$14.040	\$14.715	\$15.408	\$16.592	\$17.950	\$19.529	\$7.247
Share of Total		0.8%	0.7%	0.7%	0.6%	0.7%	0.7%	0.7%	0.7%	
Communications Services										
Telephone communications	4810	28,497	33,991	34,796	36,641	38,037	40,248	42,083	44,347	15,850
Telephone and telegraph communications	482,489	1,422	1,453	1,343	1,068	1,076	1,166	1,296	1,503	81
Radio broadcasting	4832	2,062	2,624	2,621	2,654	2,750	2,946	3,079	3,319	1,258
Television broadcasting	4833	3,564	4,786	4,541	4,749	4,901	5,193	5,789	6,509	2,945
Cable and other pay TV services	4840	2,551	3,270	3,475	3,865	4,155	4,541	5,373	6,029	3,479
Total Communications Services		\$38.094	\$46.124	\$46.776	\$48.977	\$50.919	\$54.094	\$57.620	\$61.707	\$23.613
Share of Total		2.5%	2.2%	2.2%	2.1%	2.2%	2.2%	2.2%	2.2%	

Source: Bureau of Labor Statistics

Table 16. Information Technology Industries: Annual Wages Per Worker

	SIC	1985	1990	1991	1992	1993	1994	1995	1996	Change 1985-1996	AAG 1985-1996 (Percent)
Average All Private Industries		\$18.843	\$23.209	\$23.952	\$25.375	\$25.746	\$26.248	\$27.164	\$28.352	\$9.508	3.8
IT Industries		\$27.768	\$36.248	\$37.781	\$40.644	\$41.781	\$43.091	\$45.420	\$48.488	\$20.720	5.2
Hardware											
Electronic computers	3571	32,689	46,406	48,597	52,360	54,655	55,629	59,563	62,379	29,690	6.1
Computer equipment wholesalers	5045pt.	34,908	46,314	49,238	52,492	52,947	52,880	54,299	57,536	22,627	4.6
Computer equipment retailers	5734pt.	20,478	29,051	31,105	32,243	30,553	32,072	33,769	34,605	14,128	4.9
Computer storage devices & peripheral equipment	3572,7	28,114	35,938	39,003	41,194	42,650	42,901	46,517	50,501	22,387	5.5
Computer terminals, office and accounting machines, and office machines, n.e.c.	3575,8,9	28,738	39,259	41,254	43,253	44,806	44,330	46,568	49,537	20,799	5.1
Electron tubes	3671	26,808	32,257	34,410	38,364	37,581	39,755	41,875	40,774	13,965	3.9
Semiconductors	3674	28,206	38,109	40,544	44,480	47,362	49,537	53,801	55,149	26,943	6.3
Printed circuit boards, electronic capacitors, resistors, coils, transformers, and connectors	3672,5-8	18,453	24,209	25,230	25,690	26,460	27,479	28,294	29,616	11,163	4.4
Electronic components, n.e.c.	3679	21,772	27,051	28,838	29,715	30,651	31,947	32,912	34,371	12,600	4.2
Industrial instruments for measurement	3823	24,528	31,697	32,995	35,082	35,835	37,048	38,427	40,464	15,936	4.7
Instruments for measuring electricity	3825	26,661	36,802	39,596	42,497	43,984	48,188	51,559	54,029	27,369	6.6
Laboratory analytical instruments	3826	27,973	34,400	35,907	38,719	39,217	42,639	44,235	47,727	19,755	5.0
Hardware		\$28.098	\$37.598	\$39.871	\$42.375	\$43.277	\$44.173	\$46.279	\$48.494	\$20.396	5.1
Software/Services											
Computer programming services	7371	29,311	41,857	43,053	46,222	47,552	50,057	52,731	57,818	28,507	6.4
Prepackaged software	7372	32,933	45,505	49,413	56,995	54,489	56,976	63,700	70,821	37,888	7.2
Prepackaged software wholesalers	5045pt.	34,921	46,318	49,343	52,594	52,903	53,012	54,437	57,572	22,652	4.6
Prepackaged software retailers	5734pt.	20,733	29,074	31,479	32,328	30,183	31,847	34,018	34,838	14,105	4.8
Computer integrated systems design	7373	31,569	43,795	44,640	48,556	49,689	52,749	54,711	59,810	28,241	6.0
Computer processing and data preparation	7374	23,228	30,452	30,772	34,374	36,131	36,625	39,749	43,098	19,870	5.8
Information retrieval services	7375	25,121	32,704	35,044	36,704	38,896	38,583	42,197	46,501	21,380	5.8
Computer services management, rental and leasing, and maintenance and repair	7376,7,9	30,345	41,185	43,242	45,970	46,830	48,924	51,827	57,150	26,804	5.9
Computer maintenance and repair	7378	26,929	34,296	34,071	36,589	37,488	37,236	37,819	40,072	13,143	3.7
Software/Services		\$27.683	\$38.764	\$40.413	\$44.329	\$45.292	\$47.224	\$50.721	\$55.760	\$28.078	6.6
Communications Equipment											
Household audio and video equipment	3651	26,883	28,942	30,882	32,692	33,866	36,895	32,370	35,039	8,156	2.4
Household audio and video equipment retailers	5731	12,590	18,113	18,858	19,925	19,400	20,047	20,277	20,221	7,631	4.4
Telephone and telegraph equipment	3661	28,281	37,197	38,312	42,381	45,400	46,840	49,902	55,562	27,281	6.3
Radio and TV communications equipment and communications equipment, n.e.c.	3663,9	26,624	34,468	35,484	39,077	40,326	40,065	42,735	44,173	17,549	4.7
Magnetic and optical imaging devices	3695	20,074	31,058	33,200	37,432	38,791	39,415	39,281	45,274	25,200	7.7
Communications Equipment		\$23.919	\$30.195	\$31.103	\$33.696	\$34.617	\$34.953	\$35.650	\$37.398	\$13.478	4.1
Communications Services											
Telephone communications	481	30,951	37,230	38,271	41,393	43,273	45,050	46,774	49,400	18,449	4.3
Telephone and telegraph communications	482,489	27,444	39,699	42,635	41,719	44,098	47,206	48,539	58,258	30,814	7.1
Radio broadcasting	4832	18,244	22,088	22,498	23,508	24,272	25,956	27,248	28,964	10,720	4.3
Television broadcasting	4833	30,880	41,726	39,974	41,440	42,177	43,749	47,180	50,732	19,853	4.6
Cable and other pay TV services	4841	21,633	25,994	27,148	29,594	30,507	31,426	34,553	35,238	13,605	4.5
Communications Services		\$28.885	\$35.239	\$36.015	\$38.598	\$40.122	\$41.778	\$43.731	\$46.136	\$17.251	4.3

Source: DOC's Economics and Statistics Administration estimates based on DOL's Bureau of Labor Statistics data

**Table 17. Employment in IT Occupations
By Major IT Industries, 1996**

Total All Occupations	All Industries (Incl Govt)	Private Industries (No Govt)	Non-IT Industries (Incl Govt)	Total IT	Computers	Audio & Video	Comm. Equip.	Electronic Comp.	Inst's nec	Comm.	Wholesale Trade est.	Retail Trade est.	Computer Serv.	Govt
Engineering, science, and computer systems managers	342,893	311,965	271,652	71,241	9,594	630	7,995	10,794	298	8,480	585	5	32,860	30,928
Electrical engineers	354,079	319,147	238,098	115,981	29,815	1,231	20,910	26,704	0	18,132	552	0	18,637	34,932
Computer systems analysts, engineers, and scientists	874,417	766,986	581,231	293,186	31,056	1,036	14,205	16,122	313	16,264	1,776	15	212,398	107,431
Computer programmers	548,014	513,996	324,424	223,590	14,027	268	2,424	4,049	126	9,685	1,137	8	191,866	34,018
Electrical technicians	295,707	275,440	220,928	74,779	11,486	1,395	10,117	22,133	88	11,661	2,793	1	15,105	20,267
Communications equipment operators	327,350	315,542	232,183	95,167	349	115	353	662	75	89,619	253	44	3,697	11,808
Computer operators	285,261	241,038	231,651	53,610	1,685	145	801	1,306	224	6,408	964	8	42,068	44,223
Broadcast technicians	44,058	43,847	9,699	34,359	0	0	0	0	0	34,359	0	0	0	211
Data entry keyers	17,828	17,828	13,205	4,623	0	0	0	0	0	0	0	0	4,623	0
Duplicating machine operators, etc.	196,039	162,787	187,538	8,501	245	0	147	127	0	2,370	212	23	5,377	33,252
Billing machine operator, etc.	100,614	97,724	98,145	2,469	0	0	0	0	0	850	549	9	1,060	2,890
Central office and PBX installers	77,786	77,786	27	77,759	0	0	0	0	0	77,759	0	0	0	0
Data processing equip. repairers	76,050	75,411	44,266	31,784	2,169	0	100	0	0	437	1,320	0	27,758	639
Electrical powerline installers	106,749	103,512	86,588	20,161	0	0	0	0	0	20,161	0	0	0	3,237
Electronics repairers	53,308	38,930	46,436	6,872	0	249	1,958	1,850	0	2,391	424	0	0	14,378
Cable and TV Line Installers	200,621	199,951	46,013	154,608	0	0	0	0	0	154,608	0	0	0	670
Electrical equipment assemblers	194,286	194,286	88,497	105,789	46,047	1,146	16,402	42,194	0	0	0	0	0	0
Electromechanical equipment assemblers	50,859	50,859	35,332	15,527	4,089	0	3,573	7,688	177	0	0	0	0	0
Electronic semiconductor processors	58,276	58,276	1,754	56,522	1,828	0	98	54,596	0	0	0	0	0	0
	4,204,195	3,865,311	2,757,667	1,446,528	152,390	6,215	79,083	188,225	1,301	453,184	10,568	113	555,449	338,884
Total Net Employment equals IT Industry Employment		4,637,900												
plus Employees with IT Jobs in Non-IT Industries		2,757,667												
Total Net		7,395,567												

Source: DOC's Economics and Statistics Administration estimates based on DOL's Bureau of Labor Statistics data

**Table 18. Employment in IT Occupations
By Major IT Industries, 2006**

Total All Occupations	All Industries (Incl Govt)	Private Industries (No Govt)	Non-IT Industries (Incl Govt)	Total IT	Computers	Audio & Video	Comm. Equip.	Electronic Comp.	Inst's nec	Comm.	Wholesale Trade est.	Retail Trade est.	Computer Serv.	Govt
Engineering, science, and computer systems managers	497,960	459,916	379,949	118,011	9,670	674	8,761	14,580	322	9,794	820	6	73,384	38,044
Electrical engineers	456,919	418,990	292,686	164,233	31,029	1,359	23,659	37,247	0	21,590	627	1	48,721	37,929
Computer systems analysts, engineers, and scientists	1,838,139	1,665,373	1,010,988	827,151	38,319	1,385	18,536	26,516	436	25,164	3,251	23	713,522	172,766
Computer programmers	665,227	635,804	317,735	347,492	9,700	196	1,822	3,753	91	8,137	1,125	6	322,662	29,423
Electrical technicians	338,636	319,460	247,248	91,388	9,647	1,228	8,216	29,544	77	11,578	3,317	1	27,780	19,176
Communications equipment operators	294,879	286,812	238,559	56,320	190	67	210	484	41	48,224	198	26	6,880	8,067
Computer operators	193,561	167,865	156,141	37,420	754	75	404	823	120	3,691	689	4	30,860	25,696
Broadcast technicians	50,597	50,397	12,911	37,686	0	0	0	0	0	37,686	0	0	0	200
Data entry keyers	9,879	9,879	6,438	3,441	0	0	0	0	0	0	0	0	3,441	0
Duplicating machine operators, etc.	148,785	137,321	140,161	8,624	134	0	87	93	0	1,626	166	14	6,504	11,464
Billing machine operator, etc.	99,077	96,769	96,512	2,565	0	0	0	0	0	635	483	7	1,441	2,308
Central office and PBX installers	82,321	82,321	26	82,295	0	0	0	0	0	82,295	0	0	0	0
Data processing equip. repairers	114,221	113,614	48,695	65,526	1,822	0	0	0	0	438	1,274	0	61,992	607
Electrical powerline installers	109,303	106,227	88,016	21,287	0	0	0	0	0	21,287	0	0	0	3,076
Electronics repairers	60,333	51,452	52,758	7,575	0	244	1,967	2,291	0	2,636	437	0	0	8,881
Cable and TV Line Installers	241,652	241,015	51,431	190,221	0	0	0	0	0	190,221	0	0	0	637
Electrical equipment assemblers	193,097	193,097	88,448	104,649	34,807	1,123	16,474	52,245	0	0	0	0	0	0
Electromechanical equipment assemblers	51,170	51,170	36,386	14,784	2,747	0	3,262	8,654	121	0	0	0	0	0
Electronic semiconductor processors	58,276	58,276	1,754	56,522	1,828	0	98	54,596	0	0	0	0	0	0
	5,504,032	5,145,758	3,266,843	2,237,189	140,647	6,351	83,496	230,826	1,208	465,002	12,386	87	1,297,187	358,274
Total Net Employment equals IT Industry Employment		6,212,900												
plus Employees with IT Jobs in Non-IT Industries		3,266,843												
Total Net		9,479,743												

Source: DOC's Economics and Statistics Administration estimates based on
DOL's Bureau of Labor Statistics data

**Table 19. IT Employment and Average Annual Wages:
Workers With IT Occupations in Non-IT Industries
Plus All Workers in IT Industries, 1996**

Occupations	All Industries (Incl. Govt)	Non-IT Industries (Incl. Govt)	Mean Wage (\$ per hour)	40-Hour Week (\$)	52-Week Year (\$)	Annual Wages Non-IT Industries IT Occupations
Engineering, science, and computer systems managers	342,893	271,652	31.58	1,263.20	65,686.40	17,843,835,048.87
Electrical and electronics engineers	354,079	238,098	25.59	1,023.60	53,227.20	12,673,270,320.57
Computer systems analysts, engineers, and scientists 1/	874,417	581,231	26.40	1,056.00	54,912.00	31,916,558,934.37
Computer programmers 2/	548,014	324,424	23.25	930.00	48,360.00	15,689,158,064.74
Electrical and electronic technicians and technologists	295,707	220,928	16.25	650.00	33,800.00	7,467,364,209.76
Communications equipment operators 3/	327,350	232,183	11.65	466.00	24,232.00	5,626,266,055.16
Computer operators	285,261	231,651	11.97	478.80	24,897.60	5,767,563,239.34
Broadcast technicians	44,058	9,699	14.92	596.80	31,033.60	300,994,886.40
Data entry keyers	17,828	13,205	8.88	355.20	18,470.40	243,901,632.00
Duplicating, mail, and other office machine operators 4/	196,039	187,538	9.14	365.60	19,011.20	3,565,314,661.43
Billing, posting, and calculating machine operators	100,614	98,145	9.50	380.00	19,760.00	1,939,352,685.09
Central office and PBX installers and repairers	77,786	27	19.16	766.40	39,852.80	1,076,025.60
Data processing equipment repairers	76,050	44,266	14.16	566.40	29,452.80	1,303,749,280.20
Electrical powerline installers and repairers	106,749	86,588	18.23	729.20	37,918.40	3,283,278,419.20
Electronics repairers, commercial and industrial equip.	53,308	46,436	16.25	650.00	33,800.00	1,569,521,116.80
Telephone and cable television line installers	200,621	46,013	15.16	606.40	31,532.80	1,450,918,726.40
Electrical and electronic equipment assemblers	194,286	88,497	10.23	409.20	21,278.40	1,883,074,564.80
Electromechanical equipment assemblers	50,859	35,332	10.94	437.60	22,755.20	803,986,726.40
Electronic semiconductor processors	58,276	1,754	11.70	468.00	24,336.00	42,685,344.00
	4,204,195	2,757,667				113,371,869,941.13
Total Net Employment equals IT Industry Employment plus Employees with IT Jobs in Non-IT Industries	4,637,900				avg. per worker	48,488.00
	2,757,667				avg. per worker	41,111.52
Total Net	7,395,567					
Total Wages for IT Industries						224,882,495,200.00
Total Wages for Workers With IT Occupations in Non-IT Industries						113,371,882,619.92
Total Wages IT						338,254,377,819.92
Total Average Wage						45,737.45

ENDNOTES

1. As measured by the 1996 to 1997 change in the Consumer Price Index.
2. Testimony of Alan Greenspan in the “Monetary Policy Testimony and Report to the Congress.” February 24, 1998. <http://www.bog.frb.fed.us/boarddocs/hh>
3. In this income side approach to measuring IT industries, earned income is the concept used in measuring the size of the economy. For that reason, Gross Domestic Product is measured in terms of its total income. Total income across industries is known as Gross Domestic Income. The methodology section of this report provides greater explanation as to the use of this concept.
4. Annual average wages of the IT workforce, all employees in IT industries and all workers with IT-related occupations across all industries, was \$45,737. Annual average wages of employees in IT industries only was \$48,000.
5. As a result, actual prices have dropped in some cases, and quality-adjusted prices have fallen even more rapidly. Deflating nominal output by quality-adjusted prices results in relatively rapid growth in the estimate of real output. This strong real growth boosts the contribution of these industries to total real growth in the economy well above their contribution to nominal growth.
6. Gross Domestic Income (GDI) was used as the measure of the economy for basing the estimates of IT industries contribution to real economic growth. See the section titled “Data and Methodology” for more information regarding GDI.
7. Year-to-year change in chain weighted 1992 dollar value added cannot be calculated directly. Rather, IT value added by industry is rebased using the movement of the real dollars to rebase the nominal. A more complete description is provided in the “Data and Methodology” section.
8. Intel, “Moore’s Law: Changing the PC Platform for Another 20 Years,” <http://developer.intel.com/solutions/archive/issue2/focus.htm>.
9. Inflation in the overall economy as measured by an implicit price deflator for GDI.
10. Estimates derived by adding chain-weighted 1992 dollars.
11. David, P.A. “Computer and the Dynamo, The Modern Productivity Paradox In a Not-Too-Distant Future.” Stanford University.
12. Thomas Edison’s Pearl Street Station in New York City began generating electricity on September 4, 1882. Smithsonian Institution, National Museum of American History.

13. Workers with IT-related occupations in IT industries are already counted in the employment by industry totals. To avoid double counting, they need to be included in the industry side or the occupation side, but not both.
14. Warnke, Jacqueline. "Computer Manufacturing: Change and Competition." *Monthly Labor Review*. August 1996. p.20.
15. IT-related occupations are described using the BLS *Occupational Outlook Handbook* and can be found at <http://www.bls.gov/ocohome.htm>.
16. Sternberg, Gary. "Jobs Associated With the Internet." *Occupational Outlook Quarterly*. Bureau of Labor Statistics. Summer 1997. pp.2-9.
17. Bureau of the Census. Current Population Survey Table No. 671. "Workers Using Computers on the Job: 1993." <http://www.census.gov/prod/1/gen/95statab/labor.pdf>
18. In some cases, industries were considered to be included if they incorporated computer or semiconductor technology as an integral part of its inputs. A whole host of industries could have been included in this category; e.g., Metal Cutting Machine Tools (SIC 3541), Autos (SIC 3711), and Aircraft (SIC 3721), and Electromedical and Electrotherapeutic Apparatus (SIC 3845) to name a few. To be conservative, we added a narrow subset of these industries; i.e., industrial instruments for measurement, instruments for measuring electricity, and laboratory analytical instruments.
19. OECD ICCP Committee. "A Draft Definition of the ICT Sector." A discussion document prepared by the Statistical Panel. August 1997, pp. 28-47.
20. American Electronics Association. "Cybernation, The Importance of the High-Technology Industry to the American Economy." May 1997, chapter titled "AEA's Definition of the High-Tech Industry."
21. For a discussion of the statistical discrepancy and the relationship between the product and income side approach to GDP accounting see:

Lum, Shirley K. S. and Robert E. Yuskavage. "Gross Product by Industry, 1947-96." *Survey of Current Business*. November 1997. pp. 20-34.
22. Publications and data can be accessed on the Internet. The Census home page can be accessed through <http://www.census.gov> while the BEA home page can be accessed through <http://www.bea.doc.gov>.
23. BEA estimates of gross product were not used for the other IT industries since the BEA industry series does not match exactly with other IT industries.

24. Seskin, Eugene and Robert Parker. "A Guide to the NIPA's." *Survey of Current Business*. March 1998. pp. 26-68.
25. Grimm, Bruce T. "Price Indexes for Selected Semiconductors, 1974-96." *Survey of Current Business*. February 1998. pp. 8-24.
26. Katz, Arnold and Shelby Herman. "Improved Estimates of Fixed Reproducible Tangible Wealth, 1929-1995." *Survey of Current Business*. May 1997. p. 75.
27. Bureau of Labor Statistics. *BLS Handbook of Methods*. Bulletin 2940. April 1997. <http://www.bls.gov/pdf/homch5.pdf>

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